THE

ELECTRICAL REVIEW.

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THE

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LIMITED LAWS AND UNLIMITED FRAUDS.

THE address of the Lord Chief Justice to the new Lord Mayor has attracted considerable attention, and been described as a remarkable speech. There seems to us, however, to be something less remarkable in the address itself than in the fact that it should have been delivered. For what are the circumstances? The Lord Chief Justice of England seized the opportunity to call the attention of the Lord Mayor of London to the existence of "fraud of a most dangerous kind which is rampant in the community, involving great pecuniary loss—largely borne by those least able to bear it—and," what he thought more important, "working insidiously to undermine and corrupt that high sense of public morality which it ought to be the common object of all interested in the good of the community to maintain—fraud blunting the sharp edge of honour and besmirching honourable names." When the personification of English justice declares that such evils are rampant, it is a tacit admission that the law which he administers does not provide for their suppression; and this was practically the reason for Lord Russell's remarks. He "considered it time that public opinion was aroused on this question." The public—the sufferers—who could, of themselves, initiate the remedy, have to be spurred by the Administrator of the Law to provide him with the necessary authority to cope with the frauds which he so sternly reprobates, and so lucidly exposes. What is the reason for this extraordinary apathy on the part of the public? It cannot be that the losers and gainers are as evenly balanced as the losses and gains. The majority suffers—the minority gains. Every man with a vote must have experience more or less direct of the losses incurred. But the scandal continues.

Making all allowances for the inertia natural to the law makers, there must be some reason for the lack of legislation on this subject. It is doubtless to be found in the anxiety not to unduly hamper the working of the limited liability principle. "That law has," says Lord Russell, "effected much good. Its object was to enable that to be done by honest co-operation of the many, which could not be done by the unaided efforts and resources of one or of few." The advantages which have resulted from the honest working of the Acts have been enormous, but the facilities afforded for acquiring ill-gotten gains, or wasting other people's money, whilst still walking within the law, have been considerable, too. When we are told that during the last seven years £28,000,000 have been lost to the community, and gone into unworthy pockets it would seem that the time is more than ripe for some amendment of the law, and it may be hoped that the fear of making some mistakes will no longer stand in the way of an effort to remedy the most crying evils.

It was suggested to the Lord Mayor that "he might give to the legislature the benefit of his ripe experience in commerce in advising how the existing state of things might be remedied." In eloquent words he was further reminded that he and "the great Corporation of which he was the head could do much by example, by condemnation, by ostracism of any persons who have acted a part in any such nefarious enterprises." Whatever may be done by means of the law, there is evident advantage in proclaiming

a higher tone of morality and inspiring men with the conviction that simplicity of life with honesty is to be regarded as a treasure compared with showy luxury attained by doubtful means. But the race for wealth is too keen, and the desire for ease and affluence too deeply ingrained, to be readily affected by a sermon from the justice seat or ostracism by Common Councillors. It will need a very stringent law and a series of "awful examples" before it is generally recognised that it is a crime to waste other people's money, sell social influence for hard cash, and prostitute the pages of the press in consideration of "deals," "options," or other methods of payment chosen simply to avoid detection or to pacify the recipient's scruples. It is appropriate for us to mention further the need for a high standard of morality amongst professional men engaged to report upon what we may call the "raw material" of many new companies. "One common cause of loss," said Lord Russell, "is over capitalisation to satisfy the greed of the promoter to cover" (amongst other stated expenses) "extravagant fees for expert reports."

An expert is employed by a promoter, and on general principles will often consider it his duty to do his best for his client by taking the most favourable view of the subject submitted to him, or, his report will be strictly accurate, capable of the most complete demonstration scientifically, yet, when used in a commercial sense, will convey to the non-scientific an impression the reverse of true. There is need for a broader view of their functions by experts. They should take up the position of a judge rather than that of an advocate, and in every case in which their report is intended as an aid to obtaining capital, they should consider the impression which will be conveyed to the uninitiated, rather than limit themselves to the precision and accuracy only to be understood by those as well informed as themselves. It would also be a good plan if an expert were to make it a condition of the publication of his report that the prospectus should be submitted to him. A meaning may be read by the promoter and expressed in the prospectus which the expert had no intention of conveying. We are considering here the most favourable case. No precautions are to be suggested to meet the report of the "expert" who is only "eminent," the "authority" who is only "great," to the author of the prospectus. We ought to be content to appeal to the highest motives, but in an age when the commercial spirit permeates even the professions we may be pardoned for remembering that the value of opinions is in proportion to the confidence that may be placed in them, and if the expectations of success are continually falsified by results, there will cease for a time to be any demand for such reports at all. Such is the fatuity of the investing public, that after a while the repetition of an old dodge conjures their subscriptions with ease. We may illustrate one feature of this fatuity, and, at the same time, the advantage to a company of the capable director with some sense of responsibility, such as Lord Russell would desire to find more general. In the early eighties there were issued simultaneously the prospectuses of two companies seeking to embark in electric lighting. One was a company acquiring rights in a single patented article for a single English county. There were large payments for these rights. The other company sought capital for the development of electric lighting, without regard to any particular system, or any particular area. It paid away no money for patents or promotion. The first was subscribed for about four or five times over; the second received a respectable subscription, but by no means the full amount offered. The disaster resulting to the first and all its fellows is tolerably well known. The second returned, if we remember rightly, 19s. 6d. for every £1 subscribed. The company was really born before its time. A few years later, when capital was badly wanted, it would have found an excellent field for its operations; but on investigating the position after its formation, its directors saw that the time for the profitable use of the capital was not sufficiently near to justify them in retaining the shareholders' money, and they had the courage and the wisdom to dissolve the company, all the money being returned except a small fraction which had been absorbed in absolutely necessary expenses. It is not to be expected that any amendment of the laws will amend the tendency of the thoughtless investor to take his share in the speculative mania of the moment. Prudence, like sobriety, is not to be secured by Act of Parliament, but the ways of the financial transgressor may be made less easy, and we earnestly hope that certain glaring defects in the administration of the Limited Liability Laws may be the nearer to being remedied by the outspoken utterance of the Lord Chief Justice.

The Physical Society's Meeting.

When a member of the Council of a learned society informs the author of a paper, under discussion, that the subject might have been discussed to greater advantage at a meeting of some other learned body, the author scarcely knows whether to take the suggestion as a compliment or as a reproof; and those present wonder whether it is a modest confession, on the part of the speaker, as regards his own powers of criticism, an apology for their own silence, or a mere *obiter dictum*. When, therefore, Prof. Ayrton began the discussion on Mr. Albert Campbell's paper by raising the question of whether it ought not rather to have been read at the Institution of Electrical Engineers, nobody seemed to grasp the idea. Mr. Campbell replied that "The Magnetic Fluxes in Meters and other Electrical Instruments," certainly did relate to matters technical, but as his work was of the nature of a scientific investigation he preferred that it should be discussed from that aspect and by the Physical Society. It was scarcely the question for an ordinary meeting; the time and sensibilities of Fellows would be best served by entrusting the choice of papers entirely to the judgment of the Council. Prof. Ayrton and Mr. Mather, however, did good service in accentuating the principal points of interest in Mr. Campbell's paper. The effect of the earth's field on a Weston instrument appears as an important factor in determining the limits of accuracy; the pole-pieces exaggerate the earth's field, so that the errors cannot be calculated from the simple ratio of the flux of the magnet, to the earth's H measured outside the instrument. Mr. Campbell's figures differ from those obtained at South Kensington; it is probable that the variation is very different for different instruments of the Weston type, at any rate with such as are not provided with an iron case. The very ingenious method of Mr. J. H. Reeves for making comparisons and measurements of stray fields and "working" fields, promises to settle this and a great many magnetic questions. His method, judging from the short account he gave of it, is of very wide application, and we await with interest further information as to his researches. We are glad to welcome Prof. Everett to London. Quite recently he resigned the chair of Natural Philosophy at Queen's College, Belfast, after 30 years of useful work. It happens that the two papers down for reading at the Physical Society last Friday are both by former pupils of his at Belfast, one of whom, Prof. Morton, M.A., now occupies Prof. Everett's old position at Queen's. There is yet hope for Irish Natural Philosophy. Prof. Everett contented himself by reading only a very short abstract of Prof. Morton's paper on "The Propagation of Damped Electrical Oscillations along Parallel Wires." Mr. Oliver Heaviside's communication attributes the discrepancies in question to natural causes; his description of the action is particularly worthy of attention: "When a wave-train passes any point on a wire, its surface is subjected to an impulsion vibration, lasting only a very minute fraction of a second; a vibration, moreover, which is very rapidly damped. So there is *no* definite resistance."

AN IMPROVED TELEPHONE INDICATOR.

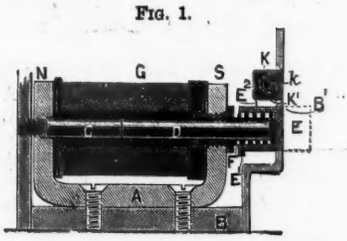
This indicator, the invention of Mr. P. Rabbidge, is an arrangement of great simplicity, and is well worth notice; it is intended to replace the shutter indicator ordinarily in use with telephone switchboards, but it may be employed in combination with ordinary electric bells, or for other similar purposes.

In figs. 1 and 2, which show one form of the indicator, A is a U-shaped permanent magnet, whose poles are marked N and S respectively, and C and D are the two parts forming the soft iron armature to the magnet.

Of these two pieces, C is fixed so as to be immovable relatively to the permanent magnet, through one of whose poles, N, it passes transversely in the direction of the other pole S.

The other of the two armature pieces, D, passes freely through a hole in the pole, S, similar to that in the pole, N,

Fig. 1.



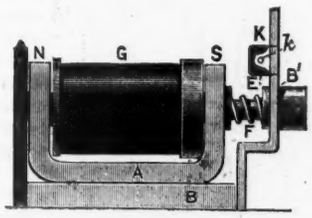


Fig. 2.

through which the piece, C, projects. The two pieces thus form when in the position shown in fig. 1 a practically continuous cylinder, bridging the gap between the two poles and so fulfilling the function of an "armature" or "keeper."

The movable piece, D, is made longer than the piece, C, and carries on its extremity a push-button, E.

F is a spring in compression which tends constantly to force the movable armature piece, D, out and away from the piece, C, but which is not strong enough to effect this when the two adjacent ends of the two armature pieces have been brought into contact, say, by hand, and adhere under the influence of the magnet, A.

Around the armature pieces and between the poles of the magnet is a bobbin, G, of such an internal diameter as not to impede the movements of the armature piece, D. This coil is so wound and so connected electrically as to oppose the magnetic flux through the armature pieces, C and D, due to the magnet, A, and when the effect of this is sufficiently powerful to allow the spring, F, to assert itself, the piece, D, flies out under its influence in the direction indicated by the arrow, F^1, and assumes the position indicated by the dotted lines. The push, E, then protrudes through the hole, B^1.

If the current in the coil, G, has ceased or fallen to so low a value as to be insufficient to effect the release of the piece, D, when the operator pushes in the push, E, so as to bring the two adjacent extremities of the armature pieces, C and D, into contact they will adhere and the push, E, remain pushed in until the next signal-current traverses the coil, G. The push, E, may bear a name or a number, or any other device or inscription upon its surface; or its movement may indicate the source of the signal, or give other requisite information by means of a shutter, as shown at K, bearing the word "London," fig. 3; the face, K^1, of the shutter which bears the inscription being turned out of sight when the two armature halves are in contact as is shown in fig. 1. The shutter is pivoted at *k*, and there engages with it a small projection, E^2, on the push, E, which imparts to the shutter a quarter revolution, thus causing the inscription to be displayed when the push protrudes through the box as a result of the passage

Fig. 3.

of a current through the coil, G, and causing the inscription to be returned to its hidden position when the operator replaces the push.

In another pattern the indicating part is the face of the enclosing box parallel to the magnet core, there being an opening in this face at which a coloured disc attached direct to the sliding part of the indicator appears when the sliding part becomes released.

All parts of the arrangement are plain, substantial, and not liable to get out of order.

ELECTRICITY AS A MEANS OF POPULARISING HEALTH RESORTS.

By G. RATCLIFFE HULME.

The authorities of health resorts, in these days of competition, are compelled to bestir themselves in the direction of maintaining and increasing the popularity of their towns. Consequently, they find it necessary to advertise largely, build parades, acquire parks, baths, and piers, and generally spend money wholesale in carrying out improvements likely to attract visitors. In the discussions which arise from time to time as to ways of means of effecting this object it is, however, seldom that any value is attached to the popularising influences of electricity. On the contrary, whenever the subject is broached at all, its value in this respect is not infrequently derided, and opponents are wont to indulge in tirades about saddling the town with an everlasting debt, and so on. More especially is this the case when the first year's working of the local electricity works results, as might be expected, in a small financial loss.

But it is strange that these opponents should so persistently burke facts, for, in the light of events, it can safely be said that the direct, and particularly the indirect, value of electricity to a health and pleasure resort is incalculable, and that money expended on a supply station is one of the best investments such a town could possibly make.

Examples proving this statement are not wanting; but perhaps the example of Blackpool stands out conspicuously above the rest. Blackpool is renowned for its immense popularity; for its invigorating breezes; for its enterprise; and its magnificent places of pleasure. Its progress has been phenomenal; and it has come to be regarded in financial circles as a solid "6 per cent." town—which can hardly be said of some of its rivals. Yet Blackpool in 1878 was unknown to the general public. It was a sandy, uncultivated place, unattractive to a degree. One asset only it had—though an inherently valuable one—ozone-laden westerly winds, and a fine expanse of open sea. Its public men, far-seeing, resourceful and enterprising as they were, determined to realise this asset, and cast about for a suitable and original method of drawing public attention to it. By rare good fortune they heard that electricity could be utilised for street lighting purposes, and ignoring all questions of cost or the risks of failure, they decided to try the experiment. Let it be said that other towns had the same opportunities of this utilisation, but they were afraid of the outcome. Accord-

ingly, they (Blackpool) obtained sanction to the borrowing of the necessary moneys for machinery and plant, and in 1879 had the satisfaction of seeing upwards of a mile of their promenade brilliantly illuminated after dusk by means of 11 arc lamps each of 6,000 nominal candle-power suspended from masts 60 feet high, placed at intervals of from 180 to 200 yards. Nor was this their only satisfaction, for they were able to congratulate themselves on being the first public users of electricity in the kingdom. The experiment, after a short initial failure, proved highly successful. Then were their anticipations abundantly realised. Thousands of visitors were attracted to the town to see the new illuminant. Reports of it were published in all the newspapers and periodicals of the country, and from obscurity, Blackpool rose to prominence, from which it has never since receded.

But, parenthetically, let figures speak for themselves. In 1871 the census returns gave the population of the township at 7,092; in 1879 it was estimated at about 9,000; in 1881 the census gave it at 14,229; in 1891 at 23,846; while in 1897 it was estimated at 40,300. The rateable value also shows the same astonishing growth. In 1879 it was £98,122; in 1881, £104,710; in 1885, £145,688; in 1889, £164,694; in 1891, £178,377; and in 1897, £290,382.

And what was the cost of this marvellously successful experiment—this master stroke of enterprise on the part of the local authorities of 1879? The capital cost of the whole of the generating plant, cables, posts, lamps, &c., complete, was £3,750, all of which was repaid in 10 years, the period for repayment of the loan. Nor was the maintenance cost high, for it appears to have averaged out at about £400 per annum, exclusive of interest and sinking fund. In this connection it will probably interest, if not amaze, present-day electrical engineers to learn that the total costs of this pioneer system for the last year's working, were no more than 4·61d. per unit, and this in spite of the fact that the lamps were only running during the season, viz., about 800 hours.

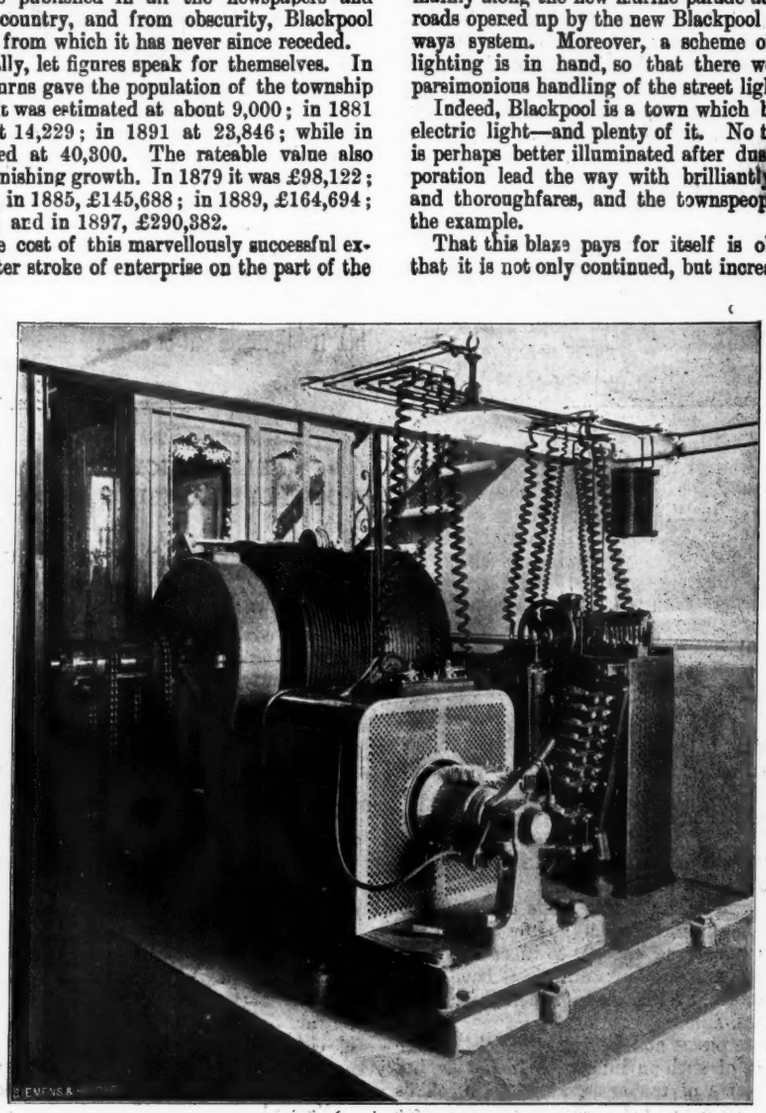
After the effects of the "boom" had worn away, Blackpool, in 1885, went "one better" than formerly, by adopting electricity as the motive power for the tramways then being constructed along the promenade. Again did success attend their experiment, and a second time Blackpool received a grand gratuitous advertisement, and became world famous in consequence. Not only so, but being, as it is, the pioneer in England of electric street lighting, and the pioneer of electric traction, it will always be accorded a distinctive place in the annals of electrical engineering.

Consonant with the ever-increasing demands, and in obeyance of its progressive instincts, the town in 1890 obtained a provisional order for the supply of electric energy in the borough for both public and private purposes. The old arc lighting plant, which had done such splendid duty for 14 years, was therefore discontinued and consigned to an honourable exile, and in 1893 Lord Kelvin opened the present electricity works.

How the new undertaking has progressed is best seen from a glance at the capital account which, standing at the opening day at about £26,000, has now reached the large sum of about £120,000. But the feature specially bearing upon the point under consideration is that of public street lighting. In the old days there were, as has already been said, 11 arc lamps, each of 6,000 nominal candle-power, in use. In 1893 this number was increased to 100, each of 2,000 nominal candle-power, spread over 2½ miles of promenade instead of one mile as formerly. In 1895 an additional 50 lamps were installed in the principal thoroughfares, and at the present time a further 100 are being erected, mainly along the new marine parade at North Shore and the roads opened up by the new Blackpool and Fleetwood Tramways system. Moreover, a scheme of incandescent street lighting is in hand, so that there would seem to be no parsimonious handling of the street lighting question here.

Indeed, Blackpool is a town which believes in light—the electric light—and plenty of it. No town in the kingdom is perhaps better illuminated after dusk than it. The Corporation lead the way with brilliantly-lighted promenades and thoroughfares, and the townspeople strikingly emulate the example.

That this blaze pays for itself is obvious from the fact that it is not only continued, but increased. As an instance affecting the value of electricity to a neighbourhood, the case of South Shore may be taken. Under the old system (1879—1893), that portion of the town known as South Shore was lighted solely by gas, and in comparison with the northern portion almost Stygian darkness prevailed after dusk. The result was, that the district did not increase like the other, and was almost overlooked by the visitor; but the introduction of electricity soon effected a complete transformation in it. It became popular, land values increased amazingly, and it is now not the least important and representative district of the borough.



Electrical Lifts.—Fig. 1.

Blackpool may be said to have risen on three waves of prosperity, and these waves attained their fulness just after the introduction of electricity in 1879, the adoption of electric traction in 1885, and the extension of electricity for private use in 1893. So that, had the introduction and use of electricity cost Blackpool three times as much as it has, it cannot be said that the town has not received full value for its expenditure. Without a doubt, the electricity undertakings have proved one of the best investments the town has made.

It is not, of course, contended that the whole of Blackpool's prosperity has rested on this foundation; but it is not too much to say that electricity has been the means of bringing the town before the public—has been the secret of its success—and as such it stands as a brilliant example of realised faith in electricity, and forms an incentive to electrically weak-kneed authorities of health resorts to follow in its footsteps.

Perhaps the time has gone by when the like results can be achieved by a place similarly situated to Blackpool in 1897. One reason for this is that electricity is not now, as then, something novel, and therefore attractive, but something in almost universal use. At the same time, it is just because of this universality of use that its adoption is absolutely essential in all places depending upon visitors for existence. In fact, the absence of electricity in such places is as noticeable now as its presence was formerly. Without electricity, a town—particularly a health resort—is stamped at once as a laggard, behind the times, deficient in vigour and enterprise. Electricity improves a neighbourhood, gives it an air of prosperity, and lifts it up the æsthetic scale. It must not be forgotten that people nowadays have become accustomed to a high state of illumination. They look for it, even on a more lavish scale, in the towns they visit, and if they find instead the parades, thoroughfares, and shops miserably lighted, they are not long in coming to a decision not to visit that place again. They require not only fresh air, beautiful scenery, artistic thoroughfares, but brilliancy and gaiety. A dull town naturally breeds dulness, a gay town gaiety and exhilaration of spirits; and the aim and object of a health or pleasure resort should be to brace up the mental powers no less than the physical. Let it be understood, therefore, that nothing pays better than a lavish, even an extravagant, display of lighting, and that no investment is better than in an electricity works.

The majority of health resorts in the kingdom are already electrically lighted, or have supply stations in progress; but there are several still outside the pale. To the authorities of these latter places the above remarks are more especially addressed.

ELECTRICAL LIFTS.

Two kinds of lifts driven by electric power are built by the firm of Siemens & Halske, one of these being for moderate speeds and the other for more rapid work. The motor in both these cases is usually connected to the windlass by worm gear.

In lifts for moderate speeds, the motor, which may be direct current, alternating current, or drehstrom, is set in motion by means of the automatic starter, fig. 3, which has been in use now for a number of years. The controlling rope takes off the brake and connects up the motor to the network by means of the switch, fig. 2, the whole starting

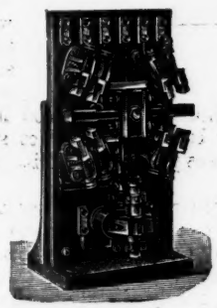


Fig. 2.

resistance being in series with the motor. The motor is now set in motion. A centrifugal governor driven from the shaft of the motor or the windlass, or a relay connected up to the brushes of the motor, switches out the starting resistance when the speed exceeds a certain amount, or when the E.M.F. at the brushes exceeds a certain amount.

The automatic starter and the switch have carbon contact surfaces, on one side at least, since metal contacts are liable to be fused together by overloading.

Fig. 7 shows a lift windlass which is set in motion by means of the automatic starter.

For lifts of higher velocities and short travel, hand control by means of the rotary starter, fig. 6, is preferable. This starter is exactly the same whether the direct current or drehstrom is used. By means of the controlling rope the mechanical or electrical brake is taken off, and the vertically standing lever of the starter is turned round in the

Fig. 3.

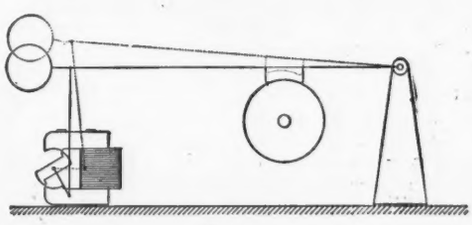


Fig. 4.

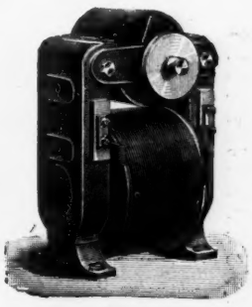


Fig. 5.

Fig. 6.

required sense, so that, first, the bottom contacts of the switch are brought together, and then those of the resistance in series with the armature are closed.

Fig. 4 shows, diagrammatically, the arrangement of the electric brake, and fig. 5 shows the electro-magnet.

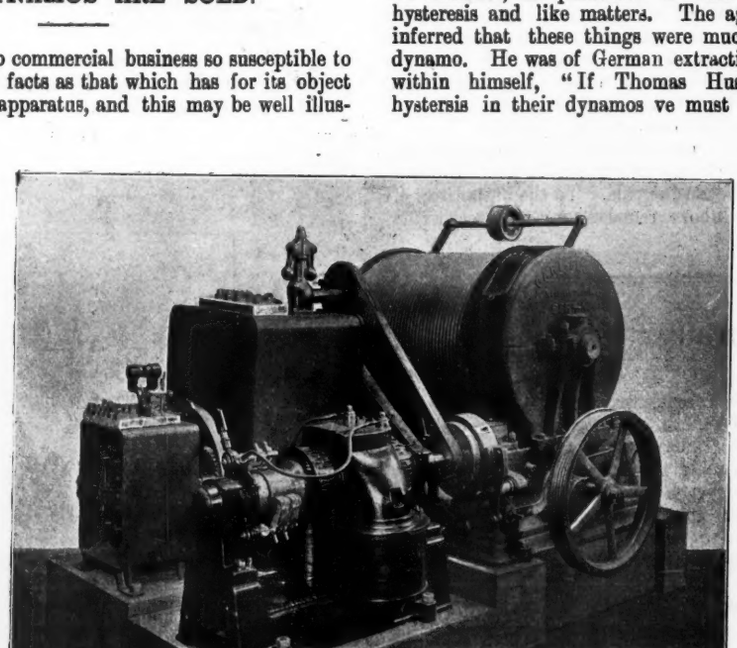
If the speed rises too high in shunt motors, resistance is thrown into the exciting circuit.

Fig. 1 shows a lift for a speed of 1 metre per second, and a load of 500 kilogrammes, for use with continuous current. It is fitted with worm gear, and a rotary starter directly controlled by the attendant by means of a rope.

To prevent accidents through the doors of the shaft being inadvertently left open, passenger lifts are fitted with an arrangement by which the motor circuit is broken if the doors are not properly shut. In the extreme positions at top and bottom carbon cut-outs are arranged, so that the current is interrupted automatically when the lift reaches these positions, in case the mechanical safety arrangements should fail.

HOW DYNAMOS ARE SOLD.*

There is, perhaps, no commercial business so susceptible to ingenious twisting of facts as that which has for its object the sale of electrical apparatus, and this may be well illustrated by the common practice of a good dynamo salesman. Let us suppose, for instance, that we have a capitalist who wishes to instal in his office building a 500-light dynamo. Relying on his own business shrewdness, which has stood him in stead for many years, he writes to a number of dynamo builders, and is soon surrounded by their agents, who are anxiously bidding to secure the contract. The various prices are submitted, each agent bidding on the nearest size which he manufactures. If the quality of the machines are equal in every case, the bids will be very close indeed, and in a measure proportional to the size of the machines. The capitalist will review the bids carefully and then talk with each of the representatives upon the merits of the machines in order to make a decision.



Electrical Lifts.—Fig. 7.

The lowest bidder does not need to argue very eloquently. He has the initial advantage, but it is not an infrequent occurrence that the highest bidder can readily carry off the palm. The shrewd agent will soon see that his price is high and will admit as much to his prospective purchaser, but will say: "These other gentlemen are bidding on machines which will carry 500 lights and no more. The machine that I propose to supply you is specially designed to carry an overload of some 50 per cent. for four or five hours. The conditions of your load might be such that you will find this an extremely valuable feature. We rate our machines very liberally and allow ample margin for contingencies; for this reason we think we justly ask better prices."

The prospective purchaser will take this matter very much to heart, and the chances are strongly in favour of his buying a 600-light machine disguised under the name of a 500-light machine able to carry overloads. If the agent had said that his machine would carry 600 lights, the buyer would have said, "I do not want 600 lights, 500 lights is ample," but the idea of getting added capacity for practically the same money is most attractive.

Again, we have the case of the purchaser who has pretentions to electrical knowledge. In no case is the old proverb, "A little learning is a dangerous thing," more forcibly illustrated. The chances are 10 to 1 the agent knows about as much of electricity as the purchaser, and the way they exchange high-flown technical terms to their mutual mystification is amusing in the extreme. To illustrate an actual case in point may be mentioned an instance where a certain man had been considering the relative merits of several bids for a dynamo machine for his factory. Some of the agents had been talking knowingly of losses, efficiency, rise of temperature, hysteresis, and other matters relative to the performance of a dynamo. The purchaser gathered that these various quantities were desirable qualities, arguing to himself if these were not such the agents would not have mentioned them, or more probably obtaining his idea from inference rather than argument. When the next bidder appeared and asked for an audience, he proceeded to talk of temperature rise, hysteresis and like matters. The agent likewise, at once inferred that these things were much to be desired in a dynamo. He was of German extraction and he communed within himself, "If Thomas Huston and Edison haf hystersis in their dynamos ve must haf some too." He succeeded, however, in arguing so well that he closed the contract, one of the inducements being that he should write to his firm and stipulate particularly that in the dynamo to fill this order there should be an exceptional amount of hysteresis.

Again, we are told of a case which seems hardly worthy of credence, but is said to be an actual fact, that of two bidders, one making a proposition on an iron machine and the other submitting a price on a machine with a cast steel frame, the former secured the contract, arguing that his machine was the heavier by some 400 lbs., and therefore more substantially built, and was not starved of iron or copper, and there was plenty of material there to stand the load, &c., &c.

A good agent will make talking points out of nothing, advantages out of disadvantages, and virtues out of necessity, and will carry off a contract at a high price, while a man of mediocre business ability with a better machine and scrupulously careful of what he says, will fail to secure the order.

Capitalists do not seem to appreciate cautious, conservative opinions. They must be superlative or they are adverse. Truly said the great showman: "The American public likes to be fooled," and the capitalist most of all. He will not invest his money unless the facts are highly coloured, even to misrepresentation.

* *American Electrician.*

ROTATORY CONVERTERS.

These machines seem to have a useful future before them in long distance transmission of power, for electric traction and other purposes, but their very existence is a standing testimony to the fact that whatever the merits of alternating

currents, it is found necessary in many cases to convert them into continuous currents.

If alternating currents were equally good for power and other purposes, there could be no use for rotatory converters to make them continuous.

There may be some rare cases wherein a continuous current supply from a station may be required to send electrical energy to a distance too great for the 450 volts at the station. In such a case a rotatory converter could be used to convert into alternating current with a step-up transformer transmitting at high pressure to the distant point. If the energy is required at the distant point as continuous current, we should require another step-down transformer and another converter to work back to the original form.

The rotatory converter may look a charmingly simple machine standing by itself, but when we consider it as above set up complete for transmission work, we see some complications, and as every conversion means a loss, we may make a rough estimate of the losses in such a system as we have sketched.

We have taken all the elements of the combination as follows:—

First rotatory transformer efficiency ...	90 per cent.
Step-up alternating transformer efficiency	90 „
Line conductors efficiency	90 „
Step-down transformer efficiency ...	90 „
Second rotatory transformer efficiency ...	90 „
Final result	59·04 per cent.

Showing an efficiency of nearly 60 per cent. This low efficiency is due to the multiplicity of the conversions, better efficiencies for the elements of the system could, perhaps, be obtained in practice, but we have our doubts about that.

The foregoing is the most complex case, beginning with low pressure continuous, and ending with the same, losing 40 per cent. in transmission.

The more simple case of beginning from high pressure alternating and reducing again to low pressure continuous requires only a step-down transformer and a rotatory converter, with, of course, the line wire, the three together giving probably a final efficiency of 73 per cent.

The simplest case is that beginning with high pressure alternating and reducing to low pressure alternating requires no rotatory converter. The efficiency is well known, as this is the ordinary method commonly in use in cities, towns, &c. It is interesting to note how the simplest systems in engineering methods are generally adopted first to any large extent.

The second case is the one in use at Niagara, and to be in use in the Central London Electric Railway.

In both instances it is doubtful whether the use of rotatory converters is of any advantage over direct generating of continuous currents.

At Niagara one would have thought that a consumer requiring 2,000 horse-power in continuous current might very well have got turbines and dynamos all to himself, getting the continuous current without the two conversions.

In the Central London Railway it is a question whether two or three separate power houses would not have been better than rotatory converter sub-power houses.

The engineers claim, of course, 95 per cent. for the efficiency of everything about the Central London Railway plant, so that they are satisfied on the score of the economy of the system, and so no doubt will everybody else who believes in the 95 per cent. efficiency of machinery; but even granted the 95 per cent., the result will not exceed, as the final transmission efficiency, 85 per cent.

All the efficiencies referred to herein are for the plant beyond the station switchboard, and up to the low pressure terminals of the distant converter. The paper read by Prof. S. P. Thompson before the Institution of Electrical Engineers on rotatory converters does not add much to existing knowledge on the subject. It is of value in drawing attention to these interesting machines, and showing that they have reached a point of perfection quite equal to dynamos and transformers.

The advent of the long-looked-for alternating motor which can be controlled and work in every way as well and easily as the continuous current motor, would, of course, to a large extent, relieve one from the necessity of using rotatory converters. It is significant that the people who claim to make the best alternating motors are the makers and users of rotatory converters. Why are three-phase motors not to be used for propulsion on the Central London Railway?

In the Electrical Review during the fall of 1893 we published a series of articles from the pen of Mr. Rankin Kennedy treating pretty fully the working and construction of rotatory and other converters.

The permutator was also described therein. The permutator may be broadly considered as an attempt to combine a stationary transformer and rotatory transformer in one machine, but the game is not worth the candle.

On the whole, electrical engineers in this country are, perhaps, justified in looking upon all converting apparatus as necessary evils to be adopted only after all attempts at a direct method have failed.

It is to be noted that we never hear of the necessity for converting a continuous current into an alternating current at a receiving distant station, it is invariably the converse problem that crops up.

THE SHOREDITCH VESTRY ELECTRIC LIGHT AND REFUSE DESTRUCTOR WORKS.

The First Year's Working Results—on paper.

The members of the Shoreditch Vestry assembled in goodly numbers on Tuesday to consider, among other matters, the report of the Lighting Committee embodying a trading account of the joint undertaking for the first complete working year ended June 24th last. A special meeting had been convened for next week to consider the position of the undertaking as indicated in the annual Vestry report, but in view of the issue of the year's accounts the meeting seems to have been shelved. Prior to the discussion of the report of the Lighting Committee, a preliminary skirmish took place because it had been discovered that a copy of the accounts had not been forwarded to the Board of Trade. Eventually the matter was referred to the Finance Committee for consideration and report. It would appear from the discussion that the accounts are so highly satisfactory that no one feels it incumbent to append his signature to them.

The year's accounts are divided into two parts, one dealing with the electric light installation and the other with the refuse destructor. The former is as follows:—

Electric Light Undertaking.

1897. Cr.	£	s.	d.
September quarter—To sale of current to consumers	549	14	2
December „ „ „ „	2,141	16	0
1898.			
March quarter „ „ „	3,410	18	9
June „ „ „ „	2,151	13	2
	£8,254	2	1
To sale of current to dust destructor from June, 1897, to June, 1898	536	5	8
„ Miscellaneous receipts, from June, 1897, to June, 1898	120	4	7
„ Sale of stores to other departments, from June, 1897, to June, 1898	130	8	4
	£9,041	0	8

Dr.	£	s.	d.
By Coal	432	15	9
„ Water	217	11	3
„ Stores, &c.	362	12	6
„ Insurance	226	0	3
„ Wages	1,472	13	10
„ Engineer's salary proportioned	145	16	8
„ Miscellaneous expenses	323	14	1
„ Rent, rates, and taxes—principally on sub-stations	33	10	3
	£3,214	14	7
„ Interest and redemption	2,641	16	2
„ Net balance	3,184	9	11
	£9,041	0	8

Commenting upon this, the Lighting Committee say:—"It will be seen from the above that the excess of income over expenditure of this part of the undertaking was £5,826 6s. 1d., and that after providing for interest and redemption of capital on this account of £2,641 16s. 2d., it leaves a surplus balance, being profit, of £3,184 9s. 11d., which your Committee cannot but regard as a very highly satisfactory result in view of the fact that in the first quarter a loss

of about £500 was actually incurred, when the demand for electricity was small. The charge for interest and redemption of capital is more than sufficient to provide for the depreciation on this undertaking, as it is really redeeming the cost of buildings and land, which will be a clear asset to the Vestry in 42 years; independent of which, all charges for the up-keep and maintenance in full working order of the plant has been included in the expenditure items of the above accounts."

REFUSE DESTRUCTOR.

Cr.	£	s.	d.
By work done for electric lighting department... ...	59	0	0
„ Trade refuse receipts	238	1	9
„ Charged to scavenging department, at 2s. per ton on 23,137 tons	2,313	14	0
„ Debit balance	1,758	14	6
	£4,369	10	3

Dr.	£	s.	d.
To Wages (including proportion of engineers and clerical salaries)	2,829	8	3
„ Stores, &c.	130	8	1
„ Carting clinker	612	10	5
„ Insurance	43	4	2
„ Current for light and power used in destructor, 128,708 units at 1d.	536	5	8
„ Sundry expenses, including water and rates, &c. ...	217	13	8
	£4,369	10	3

In regard to this part of the undertaking, the Lighting Committee say:—

It will be observed in the above accounts that your Committee have agreed with the Scavenging Committee that a fixed charge of 2s. per ton should be made against that department for the cost of disposing refuse, which will result in a saving to the Vestry (on its previous expenditure of 3s. 1d. per ton) of a sum of £1,253 5s. 1d.

With regard to the debit balance of £1,758 14s. 6d., this is represented by steam used in the lighting station and library, &c. [In future this item will be much decreased by the cost of steam supplied to the baths, which at the present has been sent up the chimney, owing to the baths not being ready.]* Even if this debit balance be charged against the surplus of the electricity undertaking, the following would be the net result to the Vestry of the combined scheme:—

	£	s.	d.
Credit balance on electricity undertaking	3,184	9	11
Add saving on previous expenditure of barging refuse	1,253	5	1
	£4,437	15	0
Deduct debit balance on destructor	1,758	14	6
Net profit and saving	£2,679	0	6

In view of the high initial cost of disposal of clinker, and the sale of electricity being very small at the commencement of the year, your Committee think the above result one upon which they can well congratulate themselves, and they are advised that no previous municipal electrical undertaking has ever yielded such a result in the first year of working. Moreover, it is manifest from the increased supply of electricity now being given and the reduced cost of disposal of clinker and the use of the exhaust steam for heating the baths, that the result for the second years' working should show an immense advance upon the above accounts, although it must be borne in mind that the prices have been reduced 25 per cent., which is the lowest charge in London, and compares favourably with any provincial station. In the above accounts, all charges for repairing and maintaining the destructor, cells, building, &c., have been included.

The Committee, therefore, recommended that the report be received, and referred back to the Committee to allocate the disposal of the profits.

DISCUSSION.

Mr. H. E. KERSHAW, chairman of the Lighting Committee, moved the adoption of the recommendation. In doing so, he explained that the accounts were before the Committee at its last meeting, when the members were fairly unanimous in recommending their adoption. The report was merely a trading account of the joint undertaking for 12 months. In his opinion, the figures were set down very clearly, and the accounts would commend themselves to the Vestry.

Mr. H. WELLS asked where the money (profits) was, as the chairman of the Finance Committee said it was nowhere to be found. It was nonsense to talk like that, because the collectors had gathered the money and paid it into the bank.

Mr. A. C. HODDER hesitated to say anything against the balance-sheet because he might be told he was opposed to the scheme. That was, however, not his intention, but in order to arrive at a fair balance it was necessary to take into consideration the dust and scavenging accounts for the year. At the opening ceremony Mr. Kershaw had stated that the difference between the cost of barging and burning was £2,200 per annum to the credit of the latter, but the speaker ventured to say that that anticipation had not been realised. Then with regard to the public lighting the total increase under that head was £1,718, although he admitted that the light was much better. The only way to arrive at a proper conclusion was to have the whole question of public lighting and the cost of barging compared with previous years.

Mr. J. J. FREEMAN, chairman of the Wharf Committee, thought the matter should be placed before the Vestry as accurately as possible. In the first place he stated distinctly at the meeting of the Lighting Committee that the dusting department were only paying 3s. per ton for barging, and not 3s. 1d. as given by the Committee. That was a difference of one penny which represented a respectable total. It was stated in the report that the disposal of the refuse in the destructor had resulted in a saving of £1,253 over the previous expenditure at 3s. 1d. per ton. That was not so, because it cost the parish more with the destructor than with the wharf. For instance, the year previous to sending the refuse to the destructor, 14 vans daily were used in the summer and 20 in the winter, whereas in the present financial year they employed 20 vans in the summer and 20 in the winter. That disposed of the sum of £1,253, being a saving to the parish. They had had to purchase additional horses, pay extra wages for 12 men, and provide further rolling stock, and the total expenditure amounted to £1,712. Before the dust was sent to the destructor, the wages paid annually were £315 less than they were at present. The cost of conveying refuse to the destructor had been much increased by the insufficiency of the lifts, and by the time the men had to wait. He had five tickets from the Lighting Committee for November 11th, and those represented five horses and vans that had to wait for an aggregate period of 6 hours and 42 minutes at the destructor to effect delivery. It was unfair to say that the ratepayers' money, to the extent of £1,253, was being saved when such was not the case. Moreover, the Lighting Committee, instead of taking four or five loads a day, were only receiving three loads, and that was not an infrequent occurrence. To charge the scavenging department 2s. per ton for disposal at the refuse destructor was worse than 3s. per ton at the wharf, and it was not right to refuse refuse, for it to be barged away, as in a case mentioned by the speaker, and to burn coal at the works in its place.

Mr. J. HEPBURN desired to know who was responsible for the trading account. There was £536 charged for the supply of current to the destructor, but there was nothing charged to the lighting department. The speaker then compared the amount of £33 in the case of the rates for the electric lighting branch with the sum of £217 placed upon the refuse destructor in the same category, the former being regarded as greatly insufficient. In his opinion the balance-sheet was a false one.

Mr. G. W. HOWLETT contended that the joint report of the Lighting and Scavenging Committee* ought to have been considered by the Vestry before it was decided to fix 2s. per ton as the charge upon the scavenging department for the disposal of refuse in the destructor. As Mr. Freeman had stated, the 2s. per ton was not a saving to the scavenging department of £1,253, but the expenses had been greater. The profits were bogus. What earthly reason was there for indicating an inflated profit to "show up the electrical papers?" It was all nonsense whether the electrical papers went for the scheme or not. Let it stand for itself. At the same time, the undertaking ought to be placed squarely and fairly before the public, and he thought the report should be referred back to the Committee for that purpose. As it stood, there were several items that were incorrect. There was, for instance, a charge of £1,485 a year on the general rate, and that was not an equitable amount.

Mr. H. WINKLER stated that the figures put forward by the chairman of the Lighting Committee made him still more disbelieving in any statements made by that gentleman. The figures might be taken for what they liked—it made not the slightest difference. It would be found in a few years' time that they had been bamboozled. Some people wanted to make a name, and they put that statement before the public as the parties who had done it. They hammered away in the papers: "Look at the figures, what a unique success." It was a perfect farce to go into figures, therefore he would only refer to one or two. The report stated that there was a surplus of £3,184 for the year, but there was not a penny placed in that account for steam. Even the losses of the dust destructor would not compensate, and would not until great alterations and improvements had been made in it. The speaker was not yet at the bottom, but he was getting nearer—they were getting more light and power. He had gone through some of those suppositious figures, and he would like to call this cooking accounts. He had gone his own way to work, and the decision was the same. The cost by burning was from £5,000 to £6,000; therefore if there was a profit of £2,000 on the electric lighting, there was a deficit which had to be paid out of the rates. But the figures had not been submitted to Mr. Adams, the accountant, and he would therefore not accept them as being official until they had passed through the hands of that gentleman. The speaker thought there might be a small profit of from £300 to £400, but that did not include any allowance for depreciation or taxes. Then, again, it did not include any such charges as the apportionment of the salaries of the vestry clerk and the collectors, estimated by the London County Council valuers at about £500. Those and other items showed that the boasted surplus was simply gas, and not light.

Mr. E. J. WAKELING referred to the statement in the report concerning the use of steam at the library and baths. The bulk of the steam at the baths would be exhaust steam that could not be used by the lighting station. One of the conditions when the Baths Act was adopted was that the supply of steam should be free, and he thought that the statement of charge in the report should not appear. [At the request of the speaker this sentence was subsequently withdrawn, although it is reproduced in brackets in the Committee's report preceding this discussion.]

Mr. KERSHAW, in reply to the criticism, admitted that the state-

* This sentence was withdrawn.

* This is given at the end of the discussion.

ment adduced by Mr. Hodder in regard to his remarks at the opening of the station had proved to be erroneous. The speaker was, however, honest in the assertion made at the time, which was based upon information supplied by the contractors, but it must be remembered that they had increased the working expenses by one-third by reducing the twelve hours' day to eight hours. If the destructor had not done what the contractors claimed for it, it would be for the Vestry to consider the matter when the final account came before the authority. With regard to public lighting, Mr. Hodder should remember that the charge had been reduced from 5d. to 3½d., or 33 per cent., which could not be compared with any other station throughout England, whilst the public buildings were also charged at the same rate. That resulted in a considerable decrease in the profits of the undertaking, although the Lighting Committee did not complain about it. Mr. Freeman had certainly touched the spot. If there was a weakness about the scheme it had been in the delivery of the refuse at the station. The reason was the insufficient lift accommodation, but was the Vestry to be blamed for that? He would give Mr. Wakeling the credit for having stated that four lifts were required, but the contractors had said two would do. The Vestry had, however, already passed an expenditure for another house, so as to give the Committee more storage capacity, when it was intended to provide additional lift accommodation. It was true that some of the surplus refuse had to be barged away last week, but that was because the vans arrived all at once when the men were leaving off work. When the additional lifts were provided it would be possible to deal with considerably more refuse than at present, so that in the future there would be an immense saving. Mr. Freeman had asked why 3s. 1d. was stated as the cost of barging when only 3s. was paid. Well, that was the vestry clerk's figure. The statement that the Committee took four or five loads was a little exaggerated; it was four loads, but that would all be avoided when the extra lift accommodation was ready. With regard to the charge to the dust destructor works for current referred to by Mr. Hepburn, that was heavy, but it would not occur again. At first the motors were very inefficient, there were no meters available, and it was some time before it was discovered what a large amount of current they were taking. The Committee were not trying to load the destructor with all possible expense. All such charges as maintenance of boilers, pumping room, mains, wages, and other items absolutely done for the lighting department, were allocated to that department. With regard to the remarks by Mr. Winkler, the figures had been submitted to the accountant, and he audited them. In reply to Mr. Wakeling, if the Committee had known that the baths had not required the exhaust steam they would have erected condensing plant and effected considerable economy over the supplying of water to the boilers.

Mr. Ernst A. R. Adams, the accountant, in reply to the statements made by Mr. Kershaw, said that he had not audited the accounts. The latter were sent to him to look over, with instructions not to make any alterations.

The Chairman (Mr. S. G. Porter) then put the recommendation to the meeting, and this was carried on a show of hands by 30 to 11 votes.

Charge for Refuse Disposal.

The Lighting and Scavenging Joint Committee reported having considered the question of the amount to be charged for destroying refuse in the destructor, and although the previous charge for barging refuse was 3s. 1d. per ton, exclusive of redemption of interest and capital for wharf shoots, buildings, &c., the Committees thought that the scavenging department should have the prior claim upon any profits made from the combined scheme. On the recommendation of the Committee, the Vestry decided to fix a charge of 2s. per ton against the scavenging department for destroying refuse in the destructor.

The same Committee, in order to maintain the same basis with regard to the dust destructor as exists with regard to the barging system, and in view of the fact than an amount of £2,641 16s. 2d. (which corresponds to depreciation) had been charged in the above accounts for redemption of capital, &c., whereas the valuer of the London County Council, in rating the property, estimated £800 per annum as sufficient to replace plant and machinery when worn out, recommended, and it was decided, that the charge for interest and repayment of capital of £1,435 13s. 4d., in respect of the dust destructor, land and buildings, &c., should be paid out of the general rate.

LONDON COUNTY COUNCIL.

At the weekly meeting on Tuesday, an important decision of the Board of Trade was made known in regard to the supply of electrical energy in several districts from one generating station. The particulars are given below, and it will be seen that the Board of Trade, at least for the present, does not seem disposed to adopt the recommendations of the Select Committee of the House of Commons, who, among other matters, suggested that powers should be granted for the laying of mains through one district for the supply of a distant locality.

Electric Supply in Several Areas.

At the end of last month the Highways Committee reported that the County of London and Brush Provincial Electric Lighting Company had appealed to the Board of Trade against certain decisions of the Council in disapproval of works proposed to be carried out under the Wandsworth and Camberwell electric lighting orders. The works referred to were intended to be carried out in Streatham and Camberwell, and the company proposed to lay mains from its generating station at Wandsworth across a portion of Lambeth for the purpose of supplying electrical energy in Camberwell.

In commenting upon this proposal the Highways Committee said:—"The objections to this course were, in our opinion, two-fold. In the first place it appeared undesirable to sanction the supply of electricity for the purposes of the Camberwell order from a station situated outside the area of supply under the order, as such a course would probably lead to great inconvenience at the time for purchase by the local authority. The second, and very serious, objection related to the laying of mains across a portion of the parish of Lambeth to enable the company to reach Camberwell. In this case the company obtained the consent of the local authority; but it does not appear that the Vestry of Lambeth has power to authorise the company to break up the streets in Lambeth, as it has no statutory to do so. Although the purpose of the company in crossing the parish of Lambeth was ostensibly to connect its mains in Wandsworth with its proposed works in Camberwell, the company might have supplied energy in Lambeth, a course for which it has no authority to adopt, and might have so obtained an unfair advantage over other companies which are restricted to their statutory areas."

Major Cardew held an inquiry on behalf of the Board of Trade with regard to the appeals last month when Sir Alex. Binnie and the solicitor attended to support the objections of the Council. Since then the Board of Trade has issued its award allowing the appeals so far as they relate to the works within the areas of supply authorised by the orders, subject to the following condition:—"That the undertakers give a written undertaking to the Board of Trade that they will, if and when required by the Board of Trade, provide a suitable and sufficient generating station within the areas of supply authorised, by the following orders, viz.: the Camberwell Electric Lighting Order, 1896, the St. Olave Electric Lighting Order, 1895, the Southwark Electric Lighting Order, 1892, the St. Saviour's District Electric Lighting Order, 1896, for the supply of energy in those areas."

The Highways Committee state it will be seen that the award of the Board of Trade excludes from its approval the proposed works in Lambeth outside the area of supply under the company's Wandsworth and Camberwell orders, that the written undertaking is of great importance, and that "in both respects the Board of Trade has had regard to the views of the Council."

New Works.

It was decided to grant the application made by Mr. C. S. Peach for an extension of the period within which the erection by the Vestry of Battersea, of a generating station in Lombard Road was required to be completed. The new conditions provide for the commencement of the buildings in two years, and their completion within five years.

A further application was submitted on behalf of Messrs. Siemens Bros. & Co., for the erection of six iron sheds next to Siemens Road, Woolwich. The Council decided to refuse the application on the ground that it was undesirable to allow the present frontage of the adjacent houses eastwards to be disturbed by the erection of the sheds to the line proposed.

CORRESPONDENCE.

Shoreditch Joint Scheme.—Electric Lighting and Dust Utilisation.

Referring to the recent controversy on this question, the items for the year, June 24th, 1897, to June 24th, 1898, showing the income and expenditure, are now before me, and I find the following to be the correct reading of them as a joint scheme:—

Revenue Accounts for the Financial Year from June 24th, 1897, to June 24th, 1898.

1.—*Electricity Works.*

Dr.	*Expenditure.*			
To coal (490 tons, £432 15s. 9d.), stores, water, and insurance	£1,328	19	9
„ wages (562,167 units)	1,472	13	10
„ engineer's salary (proportion) and expenses ...	469	10	9
„ parochial rates, £125 2s., and sub-station, ditto, £33 10s. 3d.	158	12	3
„ interest and redemption	2,641	13	1
„ „ „ on temporary loan (overdraft from bank)	815	9	4
„ balance carried down	1,707	16	0
	£8,504	15	0

Cr.	*Income.*		
By sales of current to consumers, &c.	£8,254	2	1
„ miscellaneous income	120	4	7
„ sales of stores to other departments	130	8	4
	£8,504	15	0

Dr. 2.—*Dust Destructor Station.*

To wages (25,404 tons)	£2,746	1	7
„ engineer's salary (proportion)	83	6	8
„ stores and charges	411	16	4
„ cost of removing clinkers	612	10	5
„ insurance	43	4	2
„ interest and redemption	1,435	13	4
„ „ „ on temporary loan (bank overdraft)	79	10	4
„ Balance carried down	344	9	2
	£5,756	12	0

Cr.

By Balance of income brought down	£1,707	16	0
„ Destroying trade refuse	238	1	9
„ Amount of money saved by use of dust destructor instead of the old method of barging of the refuse (25,404 tons at 3s.)	3,810	14	3
	£5,756	12	0
Balance of income over expenditure ... ... (Exclusive of the following items and charges, viz.: depreciation and bad debts; also management charges, such as proportion of salaries of vestry clerk, accountant's department, collectors, &c., estimated by the L.C.C. valuer to be at least £500 per annum. See official minutes.)	344	9	2

I note that these items do not emanate from the accountant of the Vestry, but from the Electric Lighting Committee, although, individually, I have reason to believe them to be correct.

I will leave the results to the judgment of your readers to find where the profit occurs of £2,000 and upwards that has been claimed for this joint undertaking, and enlighten some other public authorities.

T. W. Baker.

P.S.—I have taken the bank overdrafts as they occur at March and assume them to be the same in June.

I have read with great interest your article in last week's Review, which is certainly your best criticism of our combined scheme, and, for the present, as I am presenting the report in question on Tuesday night next to the Vestry, copy of which I will send you immediately it passes that Board, will content myself with remarking that in your usual method of criticising this scheme you make two or three gross blunders. In the first place I am not an officer of the Shoreditch Vestry; secondly, Mr. Baker's original scheme, "the patent for which I notice has lapsed," was not submitted to the Vestry when public tenders were invited; and, thirdly, as far as I am aware, the Blackheath Company have not decided against a refuse destructor, although, with your superior knowledge, you have twice stated that they have; and you misjudge me if you think it is my intention to shield this scheme and the contractors, at the expense of truth, as those Corporations who have had my private opinion on this matter can readily endorse.

That our destructor has done all the contractors said it would do, was hardly to be expected, but that our combined scheme is an assured success no one but yourself doubts.

H. E. Kershaw.

P.S.—Halpin's T. S. vessel has been at work for two weeks, and so far is giving satisfaction.

[Do Mr. Kershaw's private opinions expressed to Corporations coincide with his public utterances?—Eds. Elec. Rev.]

Gas v. Electric Traction.

In the article published in your issue of the 11th inst., you allude to some of the advantages of gas traction and mention the low first cost of the system as one which will appeal to the public. This is by no means the main advantage, as the cost of power for working, established by over two years running at Blackpool, has been found to be less than half that of electrical energy.

The chief points raised in objection to the gas traction system are smell, slowness in starting, and vibration. The first alleged disadvantage has now been entirely overcome by the adoption of special lubricating arrangements; in respect to the second, the gas car with its fly-wheel and gear for change of speed is practically as easily and quickly started as the electric car, and the last objection can scarcely be taken seriously when the engines are so carefully balanced that the car shakes less when standing with the engine running than with a passenger walking over it.

It is certainly to be hoped that the London County Council will give this system a trial on one of their lines, as this will enable the many and important advantages of a self-contained system to be better appreciated.

It is stated in your article that gas traction has been before the public for nearly 20 years, and in respect to early experiments and patents this may well be the case. As far, however, as practical work is concerned gas traction is barely five years old, and commenced with the Luhrig patents of 1893.

Allusion has been made to the difficulty of using producer gas. There is no reason to anticipate this as the Mekarski compressed air cars have for several years worked at a higher pressure than a sufficient supply of producer gas would require to be compressed to.

Speed has been advanced as one of the chief advantages of electric traction. In this respect gas is its equal, and the speed of the cars at present at work has been as high as the limit which the Board of Trade impose. Where higher speeds are permitted the gas car is just as able to meet the requirements as the electric car; a simple alteration in the gearing being all that is required.

For **The British Gas Traction Company, Limited,**
Percy Holyoake, *Secretary.*

Cost of Electricity at the Blackpool Winter Gardens.

As consulting engineers to the Blackpool Winter Gardens Company, we have been somewhat interested in your comments on the first year's working of their electric lighting plant, and regret that you should have based your criticism upon an incomplete report published in a local paper. We should like to say, in the first place, that so far as we are aware, there is no quarrel between the Winter Gardens Company and the local authorities, and that the figures prepared by the resident engineer were for the purposes of an annual report to the directors, which contained no such comparison with the Blackpool Corporation undertaking as is published in the local paper.

We are happy to supply you with the further figures you ask for, which are as follows:—

Capacity of plant	660 kilowatts.
Maximum demand	415 kilowatts.
Incandescent lamps	17,558 8-C.P.
Arc lamps	185.
Lighting hours per annum	8,760.

The output is by no means abnormal for a private plant as you seem to think, and we might mention that the Blackpool Tower Company have this year generated 350,000 units. The figures may seem excessive, but to understand what can be done at Blackpool one must go there. Interest and depreciation is fixed at 6 per cent. per annum. This may seem somewhat low, but is nevertheless higher than the amount set aside by most local authorities.

With regard to the discrepancies in the figures to which you drew attention, we would point out that in the analysis of costs the pound column only is given, and has been totalled without allowing for the shillings and pence. As an example of the ease with which slight errors of this kind can be made, the writer of the article has himself made an error of £10 in pointing out the above discrepancy. Your statement that 203,095 units at 5d. amount to £4,231 2s. 11d. is quite correct, but the editor of the local paper has omitted an item of £19 4s. for meter rents and other special charges which make the total revenue £4,250 6s. 11d. as stated. You also draw attention to the cost of water, waste, &c., and in reply we will only point to the fact that this cost is approximately the same as other generating stations of approximately the same output, viz., Aberdeen ·08, Ayr ·09, Burnley ·1, Sunderland ·11, and several others.

Your surprise at the management costs is quite natural, but is based on insufficient acquaintance with the facts. Before the company installed their own plant, an electrician had to be employed permanently to superintend the installa-

tion, and the £96 for management represents the difference in cost of management before the plant was installed—and since.

Owing to the special circumstances mentioned above, the total costs are not directly comparable with those of town lighting stations, but the works' costs certainly are, and we ourselves are quite satisfied that the figures supplied by the resident engineer are correct.

We must express our apologies for troubling you at such length, but we have done so because we think that your somewhat severe criticism tended to diminish the credit which is due to the resident engineer for the excellent results which have been obtained.

Lacey, Clirehugh & Sillar.

Testing Wires and Cables.

Referring to my former letter and the reply of Mr. F. Pooley in your November 11th issue, anent the testing of covered wire and cable, the explanations offered scarcely disposes of the phenomena, as I had already taken care to provide against dampness on the surface of the wire at the trims. It must be borne in mind, too, that the tests were made during the recent hot weather, when the thermometer registered 80° and 90° in the shade, so that dampness can scarcely have been present.

Is it possible that the excessive heat can have been an important factor in decreasing the insulation? Unfortunately the temperature of the tank was not taken.

Further tests were made with a sensitive galvanometer and a battery of 96 cells; but no fault could be traced.

Chas. F. Ashton-Pryke.

Re The Brighton Breakdown.

Amongst the various theories propounded to account for the Brighton breakdown, I am surprised to have seen no reference to the fact that a thoroughly good short-circuit on one dynamo would necessarily interfere with the excitation of all others in parallel with it. If the machines had shunt excitation only, it is evident that their E.M.F. would immediately fall to zero without waiting for any reduction of speed. With compound winding, the fall of pressure would not be complete; but the series windings alone might not suffice to maintain normal current even through their own armatures, brushes, and connecting leads.

Not being in the least acquainted with the arrangements of the Brighton station, I offer this suggestion with considerable diffidence, in the hope that it may be considered by those better qualified to deal with the matter than

B.

In your remarks on the above subject contained in your issue of November 11th, you somewhat curtly criticise my views as published in the *Electrician* of November 4th.

Being one of the "Brighton engineers" who was on the spot at the time, my remarks, even if "dogmatic," were certainly not made "in the absence of full details."

At the time of writing my letter to your contemporary, I was not at liberty to give any details, but being now in a position to do so, I herewith give the required particulars, thereby removing the "speculative and somewhat unprofitable" element from any further discussion that may arise, and enabling a comparison to be made between the various suggested causes and the actual facts.

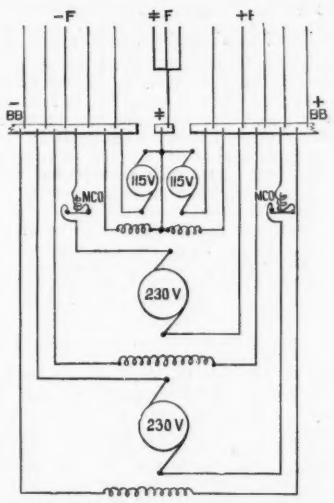
The accompanying sketch gives the conditions under which the station was running at the time of the breakdown. For the sake of clearness two only of the larger generators are shown. It will be noticed that all the dynamos were practically self-exciting and that *no* battery was in use. All the machines, with the exception of the two half-voltage balancing dynamos, were provided with minimum magnetic cut-outs on one pole and switches on the other, and were without fuses. The balances were provided with fuses, which were not affected. The shunt circuits derived their current directly from the bus bars, as shown, and were provided with two-way switches and spark-absorbing coils (not shown) By this arrangement any rise of voltage in the shunt circuit at breaking is entirely prevented.

Eight generators were running, having a total capacity of 1,400 kw. with a load of 1,170 kw. The dynamo which gave out is known as "No. 8," and is rated at 220 kw. At the time it was fully loaded, and had been running for six hours.

A fact of importance is that everything was running quite smoothly, no change of generators being in progress. The possibility of a "blunder" being the cause is therefore precluded.

The "sequence of events" was as follows:—The first indication that anything was wrong was a series of loud reports, accompanied by a shower of sparks and molten copper, with a drop of about 50 per cent. in the pressure. The light then remained steady for a period of perhaps 5 or 6 seconds, and then gradually died out, this taking probably from 40 to 60 seconds.

The cut-out of the faulty machine was *seen* to fall and was badly burned, the falling of the remaining cut-outs was heard in the dark but not seen. On inspection afterwards none of these showed any signs of burning on the contacts.



F, fuses; B B, bus bar; M C O, minimum cut-out.

The switchboard attendant immediately replaced all the cut-outs, pinning them up, and within four minutes every available generator was running and connected, but doing *no* work.

The feeder links were then disconnected, thus throwing off the load, and enabling the dynamos to re-excite, which took a period of 7 or 8 minutes, when this was accomplished the network was gradually re-connected, link by link, and everything went on again as usual. The whole shut-down lasted from 20 to 25 minutes.

A band was found loose on the armature of the damaged machine, and a large hole burned in the copper bars immediately under it.

This description is, I hope, sufficiently clear to enable your readers to draw their own conclusions. My own having been recorded elsewhere need not be repeated.

Wm. C. P. Tapper.

LEGAL.

South *v.* Mayor and Corporation of Bedford.

An Engineer's Powers under an Electrical Contract.

Before Lords Justices A. L. Smith, Rigby, and Vaughan Williams in the Court of Appeal on Monday, the case of South *v.* the Mayor and Corporation of Bedford came up. This action was brought by Mr. Harry South, electrical engineer, of 10 and 12, Garrick Street, Covent Garden, W.C., against the defendant Corporation to recover sums due under an agreement of July 24th, 1897, by which he contracted to supply at the Bedford Sewage Pumping Works two single

phase alternating current motors coupled direct to two vertical spindle centrifugal pumps, which should be capable of lifting 750 gallons of sewage per minute. Mr. Justice Phillimore, over-ruling Master Kay, had directed that an arbitrator should be appointed under Section 5 of the Arbitration Act, 1889, the defendants having refused to reject the work, and from this order the Mayor and Corporation of Bedford now appealed.

Mr. Abel Thomas, Q.C., M.P., and Mr. David Jones, were counsel for the appellants, and Mr. Neale for the respondent.

Mr. ABEL THOMAS, in opening the appeal, said under the agreement Mr. South was to be paid £600 for installing this electrical machinery, payment to be made as follows:—40 per cent. (£240) when the plant was put upon the Bedford Corporation's premises, 40 per cent. (£240) on completion, 10 per cent. six months after the completion of the works and running, and the remaining 10 per cent. at the expiration of the period of maintenance. The first £240 due on delivery of the plant was paid. On the time arriving when Mr. South claimed that the second instalment of £240 was due, dispute arose, the Corporation's engineer, Mr. Hope Johnstone, holding that as the work did not come up to the efficiency test, the contractor was not entitled to payment.

Mr. NEALE: We say that the plant is thoroughly efficient under the contract. Mr. Johnstone says it is not, and there we differ.

Mr. ABEL THOMAS observed that the matter for their lordships to decide was whether, under the contract, Mr. Hope Johnstone was appointed arbitrator to settle that question. The agreement set out that "the contractor will forthwith perform and execute, in a good and workmanlike manner, and to the satisfaction of the engineer, all and every of the work described," and so on, "the engineer" to mean Mr. W. J. Hope Johnstone. The contract provided that the combined efficiency of the motors and pumps should be from 50 to 60 per cent. at full load; that was to say, that the waste of electricity must not be more than between 40 and 50 per cent. As a fact, the borough engineer said that the efficiency was not up to 25 per cent. Exhaustive tests of the plant were to be made from time to time by the engineer, at the contractor's expense, and the work was to be performed under the engineer's direction and control; "the whole of the works, both as regards quality of material and mode of execution, must be performed and completed in an approved, workmanlike, and substantial manner, to the entire satisfaction of the engineer." The clause concerning which the substantial point of difference arose was as follows:—"The whole of the work is to be executed with due diligence and expedition. If, in the opinion of the engineer, the contractor shall fail to do so, or shall refuse or neglect to comply with any orders given him by the engineer, or shall fail to execute any other matter stipulated in the contract, the authority shall, after seven days' notice to the contractor in writing, be at liberty to employ other contractors and workmen, and forthwith perform such work as the contractor shall fail to do; or if the authority shall think fit it shall be lawful for them to take the work wholly or in part out of the contractor's hands and re-construct with other persons," and so on. On May 18th last, tests having been taken by Mr. Johnstone, the Corporation, under that clause, gave formal notice to Mr. South, and nothing being done by him they put the work into the hands of another contractor. Mr. South had not been paid. This special plant was an invention by Mr. South, and counsel thought that both were agreed that the results would be unfavourable before it was finished.

Mr. NEALE: Oh, no; it was an invention by Mr. Johnstone. It was experimental I admit, but I do not admit that it was not efficient.

Lord Justice SMITH: Where is Mr. Johnstone made the arbitrator?

Mr. ABEL THOMAS said in the terms of the clause, "If, in the opinion of the engineer, the contractor shall fail," and so on; and again, the contractor shall perform the work, "to the satisfaction of the engineer."

Lord Justice SMITH: That does not make him arbitrator. That is only a clause that if he does not do what the engineer wants, the Corporation can take it out of his hands.

Mr. ABEL THOMAS said the engineer was to finally determine, because it was to be done to his satisfaction. There was no appeal from his decision.

Lord Justice COLLINS: Mr. Justice Phillimore evidently considered that as you did not reject the work the question must go to arbitration. What is referred?

Mr. ABEL THOMAS understood the arbitrator would find what sum was due to Mr. South. His point was that the learned judge was wrong when he ordered anything to be sent to the arbitrator. All was decided by the engineer. The only arbitration clause in the contract was this: "If any dispute or difference, exclusive of all questions within the powers of or which are to be determined by the engineer, should arise, such disputes should be referred to arbitration." Here there were no differences except as to the payment of the instalment of £240 due on completion—that was to say, on efficient completion—and the efficiency tests were to be determined by Mr. Hope Johnstone, who found that the machinery was not efficient.

Lord Justice SMITH: My brother Phillimore gave you time to consider whether you would reject the work, and you have not rejected it.

Mr. ABEL THOMAS argued that if the order for arbitration stood it would take out the agreement in the contract and appoint a new umpire between the parties after they had agreed that Mr. Hope Johnstone should be the sole arbitrator. In law the power could not be taken from Mr. Johnstone unless it was shown that there was fraud or collusion—of which there was no suggestion in this case—and he submitted that the order by Mr. Justice Phillimore ought not to stand.

Mr. DAVID JONES followed on the same side, arguing that the matter which the Court was asked to deal with was solely within the jurisdiction of the engineer, and there was no power to refer it to arbitration.

Mr. NEALE, replying for the respondent, said that no question at all was raised under this contract until the electrician was on the point of completion. His first point was, the machinery having been put up and completed and ready for running, before it was run Mr. South was entitled to the second instalment of £240. Mr. Johnstone said: "No, not until I am satisfied it is efficient." Plaintiff's point was that the efficiency clause came afterwards. There remained 20 per cent., which the Bedford Corporation kept in hand until satisfied of its efficiency. As to the matters which came within the terms used in the arbitration clause, "questions within the powers of, or which are to be determined by the engineer," he said "they were only delay, negligence, or refusal to execute an order." With regard to non-efficiency, the proper remedy was to reject the work. Here was the clause: "If the work, or any part of the work, fail to pass the standard of the test specified, the engineer may totally reject such work, or parts of the work."

Lord Justice RIGBY: Do you mean that if the engineer does not exercise that power of rejection, there is no remedy at all?

Mr. NEALE: The contention is put forward that we, ourselves, have no remedy. The goods are delivered; they will not reject them, and they will not pay for them. Any part of this machinery which was defective could be remedied without trouble. Plaintiff was only a contractor who got these parts from other people. When he received the seven days' notice, Mr. South replied that the machinery was efficient, and desired to have another test, but never got it. If the engineer rejected, plaintiff could go to the manufacturers from whom he bought parts under a guarantee. Plaintiff could now get nothing, because the engineer refused to certify, and refused to reject, and he could not be sued because of the arbitration clause. Nor was plaintiff permitted to finish the contract. The only course open was taken by the plaintiff in seeking arbitration. There had never been any proper running or test, and now was the best time, when any skilled man could run down and decide as to the condition of the machinery in half an hour.

Mr. ABEL THOMAS said last May the Corporation suggested three names, Prof. Kennedy, Prof. Silvanus Thompson, and Prof. Unwin, and they offered to pay half the cost of the tests.

Lord Justice SMITH. Will you take Prof. Silvanus Thompson?

Mr. ABEL THOMAS said it was now too late, the work having been given to another contractor.

Mr. NEALE said the plaintiff was willing to take Prof. Thompson's opinion last May, but did not see why he should bear the cost. The answer to this demurrer was, "Well, as you refuse, we will take it entirely out of your hands." This machinery was still valuable. It was running at the station, and was pumping the sewage, the only fault alleged against it being that it took too large a percentage of electricity. The fact was, that only a part of these works was executed by Mr. South, the other part being put in by the Bedford Corporation itself, and Mr. South maintained that his pumps worked more than efficiently, if only the other parts were properly constructed. Mr. Johnstone said that the work was not efficient as a whole, and he would not certify. Short of an arbitration, plaintiff was absolutely without remedy, unless, as an act of charity, the engineer cared to say, "Well, I will give you so much."

Lord Justice COLLINS: If the authority is justified in taking these works out of your hands, and giving them to another contractor, then you say your remedy under clause 11 is the contract price less the cost of making good your work?

Mr. NEALE: Yes, I claim that plaintiff had said that the plant was all right. The engineer said it was all wrong. Plaintiff offered to convince them by testing it, but the place was flooded when he went down, and the test could not take place. The engineer simply reported to the Corporation that the work was inefficient, and it was taken elsewhere. Plaintiff had never refused to put the machinery right if it was wrong.

Lord Justice COLLINS: You cannot recover the certificate price because you have not a certificate, but this clause apparently lets in that you are to be paid something. Who decides? If the engineer does not you go to arbitration.

Mr. NEALE finally submitted that Mr. Justice Phillimore was right in deciding that the clause appointing the engineer arbitrator only referred to special matters, such as bad materials, delay in execution, and so on, and argued that even without a certificate plaintiff was entitled to an arbitration.

Mr. DAVID JONES, replying to a question by Lord Justice Smith, said that the Corporation had not yet made any use of the plaintiff's plant, and until that was done no issue could arise.

Lord Justice SMITH: When you use the pump, what then? Will there be an arbitration?

Mr. DAVID JONES said there had been a suggestion from his Lordship that it would be attached to the freehold. He did not think the Corporation would be so unreasonable as that.

Lord Justice SMITH: You need never say that about a Corporation.

Mr. DAVID JONES thought the engineer might calculate what was due to the electrician.

Lord Justice SMITH: I understand now why my brother Phillimore says in his order that you will not reject the work.

Mr. DAVID JONES said at present all the Corporation had done was to ask Mr. South to perform his contract. As he had not done so they had entered into another contract to make the work efficient. He submitted that all that had arisen was within the jurisdiction of the engineer.

Lord Justice SMITH then delivered judgment, observing that the question at issue was whether the plaintiff could enfore an arbitration under this agreement. The plaintiff said that the second instalment of £240 had become payable to him because he had completed the works. The Bedford Corporation's engineer said that he

had not completed the work, because he contracted to provide machinery to work up to certain tests, and as it had not worked up to those tests he refused to certify. Notice was given by the Corporation to the plaintiff to make the work efficient, and the Corporation had since, under the powers of the agreement, entered upon the work, and made a contract with another contractor to complete the work to the satisfaction of their engineer. In these circumstances the plaintiff asked for payment for the work he had already erected. That was the matter in dispute. The Corporation refused, and the plaintiff got an arbitrator appointed by Mr. Justice Phillimore under the Arbitration Act. The case for the Corporation was, that no dispute had arisen between them and the plaintiff other than that in which the engineer had exclusive jurisdiction, and that the order for arbitration was wrong. Who was to ascertain the sum payable to the electrician for the amount of work already done before it was taken out of his hands? Certainly not the engineer. It could not be found that he had to do that by this arbitration clause, reading it in any way. It seemed to his Lordship that here was a matter of dispute between plaintiff and the Corporation which did not come within the jurisdiction of the engineer, but was a matter of dispute in which the Court could appoint an arbitrator. Mr. Justice Phillimore gave the Bedford Corporation a fortnight to make up its mind whether or not it would reject the plant, which the engineer had power to do. They said they would not, and thereupon Mr. Justice Phillimore over-ruled the order by Master Kay. His Lordship thought that that order under these circumstances should stand, and that the appeal ought to be dismissed with costs.

Lord Justice Rigby: I am of the same opinion, and have nothing to add.

Lord Justice Collins: I am of the same opinion, and on the same grounds.

Mr. David Jones: will your Lordships specify what matters the arbitrator is to deal with?

Lord Justice Smith: No.

Riley *v.* Lindsay.

At the Guildhall on Tuesday before Mr. Alderman Smallman, T. Lindsay was charged with appropriating about £27, alleged to have been collected by him for and on behalf of his employers, L. V. Riley & Co., electrical engineers, Throgmorton Avenue, also trading as the Highbury Art Metal Company, by whom he was engaged as traveller on salary and commission. The defendant subjected the prosecutor to a severe cross-examination and elicited the fact that no salary had been paid him for several weeks, and that the last payment, which was made on October 10th last, was by cheque for £1 on account, which cheque, however, the defendant was not to present to the bank for payment for a few days. Eventually the charge was dismissed, the alderman remarking that there was no case against the defendant.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week Ending Nov. 15th, 1897.	£	s.
Adelaide	21	0
Albany	185	0
Alexandria	220	0
Amsterdam	45	0
Antwerp	88	0
Barcelona	10	0
Bombay	46	0
Buenos Ayres. Teleg. mat.	181	0
Calcutta	231	0
Cape Town	584	0
Colombo...	44	0
Durban	32	0
" Teleg. mat....	259	0
East London	157	0
Flushing	98	0
Genoa	767	0
Gibraltar	151	0
Gothenburg	197	0
Lisbon	67	0
Madras	440	0
Malta	79	0
Mauritius. Teleph.mat.	100	0
Melbourne	158	0
Novorossisk	8	0
Passages	188	0
Port Elizabeth	303	0
" Teleg. mat.	130	0
Rio de Janeiro	850	0
Santos	26	0
" Teleg. mat. ...	22	0
St. Petersburg	15	0
Sydney	1,036	0
" Teleg. mat. ...	23	0
Stockholm	960	0
" Teleg. wire	249	0
Yokohama	420	0
Total	£8,276	0

Week Ending Nov. 15th, 1898.	£	s.
Alexandria	120	0
Amsterdam	210	0
Boca	37	0
Boulogne	39	0
Brisbane	40	0
Brussels	110	0
Calcutta	111	0
Canterbury	24	0
Cape Town	1,534	0
Christiana	15	0
Colombo	33	0
Copenhagen	70	0
Demarara	25	0
Durban	97	0
Flushing	10	0
Fremantle	624	0
Hamburg	120	0
Hong Kong	1,737	0
Las Palmas. Telep. mat.	15	0
Madeira	12	0
Melbourne	143	0
Ostend	30	0
Perth	38	0
Rio de Janeiro. Teleg. mat.	18	0
St. Petersburg	256	0
" Teleg. mat.	180	0
Santander	20	0
Santos	68	0
Sydney	2,461	0
Trinidad...	26	0
Wellington	361	0
Yokohama	1,290	0
Total	£9,874	0

Auction Sale.—Mr. Wooller Jennings, of Bradford, will, on 21st inst., sell by auction the machinery, stock-in-trade, &c., of an electrical contractor under a deed of composition *re* Arnold Hartley. For further details of this matter see our "Official Notices" this week.

Austrian Patents.—Messrs. E. P. Alexander & Son, patent agents, are sending out a circular regarding the new patent law coming into operation in Austria on January 1st next. This law provides, *inter alia*, for an examination as to novelty, and it must be noted that any publication in Austria edited before the date of application will be considered as an anticipation, whereas formerly only such publications as were accessible to the public in Austria at the date of filing the application were looked upon as anticipatory. A patent already granted, or a patent application made before the end of the current year may, if desired, be transformed into a patent under the new law the principal advantages of transformation being:—1. A somewhat extended scope of protection and more liberal compensation for infringements. 2. An enlarged period of time in which to work the patented invention, three years in place of one year. 3. A patent cannot be annulled for non-working, except a threat of annulment be first made and a suitable term for adequate working appointed. Among the disadvantages are:—1. Higher annuities. 2. Right of the war authorities to use inventions relating to arms, explosions, &c. 3. In patents for processes, only the process is covered, the substance produced being protected only in so far that it is considered as produced by the patented process until proved to the contrary.

Bankruptcy Proceedings.—The public examination of C. H. Kitching, plumber and electrical engineer, took place on 14th inst. at Hull.

Liquidation Notices.—A petition presented for the winding up of the United Ordnance and Engineering Company, Limited, by Messrs. Lander & Larsson, creditors, of Birmingham, will be heard before Mr. Justice Wright in London on Wednesday next, November 23rd.

A similar petition presented by the Sussmann Electric Miners' Lamp Company, for the winding up of the Electric Exploitation Company will be heard in the same court on the same day.

Books Received.—"Indication of Water Levels in Steam Boilers." J. Hopkinson & Co., Limited, Huddersfield.

"Practical Engineer" Pocket-book, 1899. Technical Publishing Company, Limited, Manchester. 1s. 6d.

"Molesworth's Metrical Tables," published by E. & F. N. Spon, Strand. 2s.

"The Slide Rule," by R. G. Blaine, published by E. & F. N. Spon. 2s. 6d.

"Mechanical World" Pocket Diary and Year Book for 1899. Emmott & Co., Manchester. 6d.

"Indian and Eastern Engineer" Diary for 1899.

Bullers, Limited.—The London address of this company is removed from 32 and 33, Queen Street, to 3, Laurence Pountney Hill, E.C.

Electrical Machinery in Prussia in 1898.—The Commercial Attaché to H.M. Embassy at Berlin, in a recent report printed in the *Board of Trade Journal*, gives the following interesting facts and figures relating to electrical work in Prussia during the current year:—"Every year the increase of electrical plant is becoming more marked in Prussia; and though there are no complete statistics on the subject, a good idea of the advance that has been made is to be obtained from the data which exists as to electrical driving machinery, for this is chiefly driven by steam, and is, therefore, to be found in statistics. The latest returns for the beginning of 1898 are to be found in the following statement, which includes all State and private undertakings in Prussia, with the exception of those under the War Office and Admiralty. Of machines driving dynamos, there were in 1891, 983, with a horse-power of 49,489, whereas by 1898 this number had risen to 3,305 of 258,726 horse-power. In the former year there were 794 machines exclusively used for driving dynamos, while 189 were only partially used for this purpose. In the latter year there were 2,490 used exclusively for driving dynamos, while 815 were only partially used for this purpose. The increases here shown are enormous. It is worth noticing the great development since 1897. In that year the total horse-power was 191,935 only, whereas by 1898 it had risen to 258,726. During this interval of one year the number of machines had increased from 2,837 to 3,305. The particular kinds of electrical work to which these machines are made to supply the power, for 1898, are shown in the following table:—

Uses to which Electric Currents are put.

Uses.	No. of machines.	Horse-power.
1. For lighting purposes	2,873	154,772
2. For driving motors	61	10,785
3. For other purposes	25	7,278
4. For several purposes at the same time, and		
(*a*) For lighting and transmitting power	325	84,216
(*b*) For other purposes	21	1,675
Totals	3,305	258,726

By far the greatest part of the electric power, therefore, is used for lighting purposes. The above statistics are taken from figures published on September 30th in the *Reichsanzeiger*."

Changes of Address.—Mr. John S. Raworth informs us that his address for professional purposes is now 2, Queen Anne's Gate, Westminster, S.W., and that his telephone numbers are 678 Westminster, and 16 Streatham.

The Blackman Ventilating Company, Limited, have opened new showrooms and offices at 1, Colonnade Passage, Birmingham, to cope with business in the Midlands and the West.

Electric Traction on Canals.—The Minister of Public Works has just approved the conditions of a five years' contract for electrical traction on the Charleroi portion of the Brussels Canal.

German Electrical Schemes in the Orient.—A financial daily abstracts from *L'Orient* some notes on the economic progress which is being made by Germany in the Orient. Among other German enterprises to be mentioned in this connection are the construction of the narrow-gauge railway between Mecca and El Tor by a Berlin firm; the electric tramways of Cairo by a Belgian company, the contractors for which, however, are German; the electric light works at Sophia and Constantinople, established by Germans; and the lighting of Yildiz Kiosk by Messrs Siemens, who have secured, as is well known, still another concession for the same purpose.

German Electrical Trusts.—The financial press says that the agreement between Ludwig Loewe & Co., Schuckert & Co., and the Continental Electrical Works, forming the Loewe-Schuckert Electric Trust, has been rescinded. We referred to this matter last week.

The Institution of Junior Engineers.—On Saturday, November 12th, a party numbering over 120, visited the site of the Lombard Street Station of the northern extension of the City and South London Railway. On behalf of the engineers, Sir Benjamin Baker and Mr. David Hay, they were received and shown over by the resident engineer, Mr. James Forgie; and Messrs. Collingridge, W. G. Bennett, and O. Mack, representing Messrs. Mowlem & Co., the contractors. The feature which naturally attracted the greatest interest was the work connected with the underpinning of St. Mary Woolnoth Church.

Lists.—The Campbell Gas Engine Company, Limited, of Halifax, send us an illustrated list of the "Campbell electric lighting type" oil engine which is specially constructed for electric lighting. It is made in sizes from 4 to 40 B.H.P.

Messrs. J. Guthrie & Co., of Leather Lane, E.C., have sent us an illustrated list of their electric fittings in wrought-iron, copper, and brass. There are some very neat designs included of brackets, standards, electroliers, pendants and ceiling lights.

The British Boiler Fluid and Engineers Stores' Company, of Limehouse, send us lists of the Dejecoline boiler fluid and the Excelsior asbestos non-conducting boiler covering cement.

Locomotives on Highways.—The Local Government Board announce that with respect to the wheels of locomotives on highways they have issued an amending order further varying the provisions of Sub-section (4) of Section 28 of the Act of 1878, by the substitution for the condition numbered 6 in the order of November 26th, 1897, of the following condition:—"No such wheel shall be used, any block of which is so worn that any metal rim surrounding the block protrudes beyond the surface of the block." Circulars have been issued by the Board to the councils of counties and county boroughs, to boroughs other than county boroughs, and to urban and rural districts calling attention to the Locomotives Act, 1898 (61 and 62 Vict., c. 29), by which important changes have been made in the law with respect to the use of locomotives on highways and to extraordinary traffic.

Municipal Elections.—Mr. Fred. Turner Garrett, electrician, &c., has been elected Mayor of Dunstable. Mr. J. R. Musgrave, who has been elected Mayor of Whitehaven, has been, since the incorporation of the borough, the Chairman of the Electric Light Committee, and has had a controlling hand in the principal work in connection with the installation of the electric light in the borough. He is now undertaking to promote a Bill in the ensuing session of Parliament for extending the electric lighting district. Mr. A. G. Evans, electrical engineer, Chippenham, has been elected on to the local council. Mr. Charles Geen, electrical engineer, who has been a councillor since 1884, has been appointed first Mayor of Okehampton under the new incorporation.

New Premises.—Messrs. Wilson & Abell have opened premises in Lower Willsate, Stockport, as electrical engineers.

Organ Blowing by Electricity.—The new organ which has now been completed at Lincoln Cathedral, has cost £4,025, exclusive of £400 for electric motors and £250 for the pedal reed. The instrument is arranged on the divided principle, and is blown by electricity.

Plymouth.—Messrs. Lord & Shand have obtained the order for installing over 200 electric lamps and 80 bells in Chubbs's Hotel.

The Ruby Gas Engine.—Messrs. Thorpe & Salter, of Red Lion Street, E.C., have just introduced a small and novel gas engine known as the "Ruby." One of the engines was shown at the Brewer's Exhibition the other week connected to a small centrifugal pump, which we are informed at 500 revolutions per minute pumped water at the rate of 600 gallons per hour with a 4-feet lift and ¾ delivery. The gas consumption is about ½d. per day of ten hours. One of the features of the engine is a neat form of inertia governor very sensitive in action and adjustable while the engine is running, which is a great advantage.

Sharp & Piper.—This firm do not confine themselves entirely to the Safety Concentric System of Wiring, for they have at the present moment in hand several large contracts for plant and wiring which are not on the Safety Concentric System, owing to the fact that the system to be employed must be a doubly insulated one, and it not being possible to earth one side. In many cases, however, it is possible to adapt their Standard Concentric patterns for use with other systems, especially in the matter of switch and fuseboards, and this is being done. Messrs. Sharp & Piper have in hand several important installations on their Safety Concentric System, and others are being carried out on that method by other contractors.

ELECTRIC LIGHTING NOTES.

Abingdon.—The Abingdon District Council have appointed a committee to consider the question of cost, &c., of lighting the district with electricity.

Arbroath.—The Arbroath Town Council have defined an area in the principal business part of the town for the supply of the electric light under the proposed provisional order.

Australia.—The *Sydney Mail* recently contained the following:—"In view of the great pressure obtainable from the Tamworth mains, Mr. J. O. Callender, the well-known electrical engineer, reports favourably of the scheme now before the Council for the extension of the present electric street lighting system to private houses, electricity being generated by the surplus pressure of the water supply."

Barking.—At a meeting of the Electricity Committee, held at the public offices on Monday, Mr. E. E. Hoadley, chief assistant engineer to the Worcester Corporation, was selected, out of some 70 applicants, for the post of electrical engineer to the Urban District Council. Mr. Hoadley previously held appointments in the electric lighting stations at Islington, Eastbourne, and Chatham.

Basingstoke.—The following companies have been proposing to apply for provisional orders:—The Electrical and General Engineering Company, the United Electric Light and Traction Company, the Steam Carriage and Waggon Company. The Council has itself decided to apply for an order.

Battersea.—Last week the Lighting Committee reported the receipt of a letter from Mr. S. Morse stating the intention of the County of London and Brush Provincial Electric Lighting Company to apply in the next session for a provisional order for Battersea.

Beckenham.—The Board of Trade has written to the Council about its provisional order taken out in 1893, but not yet carried into effect. When the matter came before the Council last week, the clerk said that Mr. Angell and himself, in June last, presented a report making certain recommendations. One of these recommendations was to the effect that specifications and drawings be prepared. Tenders would be invited during the next two or three weeks. It was decided that the clerk should acquaint the Board of Trade with these facts.

Belfast.—At a recent meeting of the Electric Committee the accountant submitted a statement showing the engineer's original estimate of the cost of the new electric installation, and the sums expended in connection with it, with the gratifying result that the expenditure had been more than £400 less than the estimate, notwithstanding many difficulties which had arisen during the progress of the works. The demand for current is increasing so rapidly that until the erection of further plant, which is daily expected to hand, applications must be held over.

Bexhill.—The District Council has received permission to borrow £20,000 for electricity supply purposes.

Birmingham.—A draft of the Bill for the acquisition of the electric light undertaking by the Corporation was submitted to the General Purposes Committee on Tuesday. The Committee will report the Bill to the City Council for approval at their next meeting.

Blackpool.—The Electric Light and Tramways Committee are desirous that the Corporation should be empowered by the proposed Omnibus Bill to supply electricity beyond the borough, to accept by agreement a transfer of any adjacent local authorities' electric lighting order, and otherwise to carry out arrangements with the Blackpool, St. Anne's and Lytham Tramway Company; to make better provisions as to electric lighting meters, and to make bye-laws with respect to any electric lighting apparatus in order to secure the safety of the inhabitants and prevention of fires.

Bournemouth.—We understand that a slight mis-statement appeared in our last issue under this heading. We stated that the Bournemouth and Poole Electricity Supply Company, Limited, is applying for a provisional order for the lighting of the borough of Bournemouth, but, as a matter of fact, the company is merely asking for the consent of the Corporation to the transfer of the existing order from the Bournemouth and District Electric Supply Company to the company mentioned above. With regard to the electric lighting of Winton, we stated that the District Council has given its consent to laying wires underground through the main road. In this case, the Urban District Council has given its consent to a provisional order which the same company is promoting for the lighting of the district.

Brechin.—The Police Commissioners have been informed by the Electric Lighting Company that they expect to start in the course of six weeks.

Brierley Hill.—The Council has adopted a report of the Lighting Committee relative to the question of electric lighting and power supply by the Midland Electric Corporation, Limited, and the Dudley and Stourbridge Electric Traction Company. The report recommended the Council not to give their consent to the application for a provisional order by either company, but that the Council take the advice of an expert as to their applying for an order to supply electricity. The clerk stated that the Traction Company had abandoned their application owing to the action of the Committee.

Brighton.—The West Pier Company are going in for electric lighting, and as they will require 500 lights for themselves and their tenants, the Council has resolved to lay the necessary cable if the company will pay the cost of the main and subsequent repairs and maintenance.

Bristol.—By about the time the new plant has been put into working order for the enlarged electric light station, another lot will be required, says a local paper. The Electric Committee met last Friday, and re-appointed Mr. George Pearson and Mr. Stephen Tryon as chairman and vice-chairman respectively, and had before them a most encouraging report of the growth of the demand for the light. Up to date 893 persons had applied for the current, and 870 had been supplied. The number of 8-candle incandescent lamps demanded was 66,027, the total installations reaching 59,689. In the previous fortnight the number of customers had increased by 17, and the number of lamps by 559 for new customers, and 838 for old ones. At this rate the 80,000 lamps for which, we believe, the new plant is designed, will soon have been reached. The street lighting is being gradually extended, in accordance with the scheme approved by the Council, and, ere long, more extensions will be demanded.

Bury St. Edmunds.—As the Local Government Board will not sanction a loan for the electric lighting scheme as originally drawn up, the Council has now resolved to adopt a modified scheme, at a reduced cost of £16,000. The Council is applying for an extension of time under its provisional order.

Canterbury.—The electric light works here are now fairly well advanced, and are nearing completion. The applications for current are still coming in, and it is stated that the plant to be installed will be totally inadequate for the requirements. The suggestion was brought before the last Council meeting that application should be made to the Local Government Board for a further loan of £8,000 for additional plant and extensions. But any increase of capital was opposed by the majority of the members until it is seen that the original plant is working all right. The suggestion was therefore withdrawn. Tenders are invited locally for the wiring of the electricity works.

Ceylon.—Messrs. Boustead Bros., who have secured the contract to light the streets in the Port with the electric light, made a start with the work of laying the street light installation in October. Mr. William Simm, who has been sent out by the British Insulated Wire Company to do the work for Messrs. Boustead Bros. is directing the work. The British Insulated Wire Company have supplied Messrs. Boustead Bros. with the materials and plant necessary for the whole installation, and Mr. Simm has been sent to Ceylon to fix up the plant, &c. He is assisted by Mr. J. J. L. Fernando, of Messrs. Boustead Bros. There will be 30 1,000-C.P. arc lamps in the whole of the Port.

Cheltenham.—The Council has approved of several small main extensions proposed by the electrical engineer, at about £280.

Clonmel.—The governors of the County Tipperary Lunatic Asylum on Monday had a discussion *re* electric lighting. The question of cost formed the main point in the discussion. The matter was adjourned for a month in order that particulars might be got together by Dr. Garner for the next meeting of the governors.

Colchester.—Messrs. Siemens Bros. recently advised that the opening ceremony in connection with the electricity works be not held until the first week in December. The whole of the plant will be then in perfect working order. The plant is equal to a supply of 4,000 lamps, and up to the present applications have been received for 1,363, without reckoning the 500 required for the Military Hospital.

Colne.—The Town Council has decided to obtain information from the electrical engineer of Burnley with a view to making the necessary provision for the supply of electricity to Albert Road.

Colombo.—Mr. E. O. Walker has resigned the post of electrical adviser to the Colombo Municipal Council.

Constantinople.—A financial paper says that a company is being formed to acquire a concession for supplying electric light and power in Constantinople. This would indicate that the Sultan has abandoned his old prejudice against electricity.

Ealing.—The private lamps applied for now total 20,072, about 5,000 lamps having been added in the seven months since the close of the last financial year. We understand that the arc lamp posts are to be fitted with two 16-C.P. incandescent lamps for use after midnight.

Eccles.—At the annual Council meeting last week the recommendation of the General Purposes Committee, instructing the town clerk to take all the necessary proceedings for obtaining a provisional order under the Tramways Act of 1870, in order that the Council could use mechanical traction upon the tramways in the borough, as might be decided upon hereafter, was carried. In the course of an address, the new Mayor (Dr. Hamilton) said they were all very much disappointed that, owing to the engineers' strike, their electrical plant had not been delivered in time for them to start as anticipated. The plant, however, was nearly ready, and the orders for the current were coming in.

Edinburgh.—It is stated that during the past week or two the failure of the electric light has been so marked that complaints have been pouring in to the authorities. The primary cause of the defect in the light was the non-delivery of plant necessary for the works. When orders to supply electricity to a largely increased number of consumers were accepted it was expected that the machinery would be delivered up to time. On the contrary, of four machines which should have been ready in August, only one is actually in working order, though the parts of two others are to hand. Almost the same holds good of four boilers which were ordered for delivery in August. These, says the *Glasgow Mail*, have just been put down, but it was necessary to test them thoroughly afterwards. The result is that hitches in the working have occurred, which have driven the management to temporary expedients. The main difficulties have now been got over.

The following notice has had to be issued to consumers, signed by Mr. A. Donald Mackenzie, chairman of committee, and Mr. Frank A. Newington, resident electrical engineer:—"We much regret the inconvenience caused to users of the electric light for some time back through the fall in pressure during the time of heaviest load. Everything possible has been done to overcome the difficulty, and we hope in a day or two to be in a position to keep up the full pressure continuously. Meantime, we crave the indulgence and co-operation of the consumers, and request that as few lights as possible be turned on between the hours of 5 and 7 p.m., when most of the shops close. We think that this may be done in private houses without very much inconvenience, with beneficial results."

Finchley.—At a special meeting last week the District Council passed a resolution applying for a provisional order.

Fleetwood.—The electric lighting company are pushing forward their undertaking. Upwards of 120 shopkeepers and householders have signified their intention of taking the light.

Grimsby.—The Public Lighting Committee last week decided to recommend the Town Council to adopt plans which had been prepared for the lighting of the borough by electricity at an estimated total cost of £40,000. The necessity of the proposed agreement between the Corporation and tramway company for the supplying of the latter with electric power for running their cars being speedily completed, was urged in a letter from the company. The Sub-Lighting Committee afterwards held a private meeting, at which Mr. John Glenn, engineer of the tramway company, was present.

Hammersmith.—At last week's Vestry meeting it was mentioned that application was to be made during the ensuing session of Parliament for provisional orders, authorising the supply of electric energy for public and private purposes in Hammersmith, by the House-to-House Electric Light Supply Company, Limited, and the Kensington and Knightsbridge Electric Lighting Company, Limited.

At last week's Vestry meeting, it was decided that the surveyor should be instructed to prepare plans for a further extension of the electric lighting engine and boiler houses, and the consulting engineer to prepare plans for further extending the station plant, &c. Tenders have been given out for a new engine and alternator, as stated last week. The Electric Lighting Committee was instructed to consider and report as to further extending the public electric lighting. The Vestry agreed to contribute £25 to the defence fund, being 1 per cent. on £2,500, the Vestry's income of last year's working, in order to contest the claims of Mr. Martin Rucker.

Heckmondwike.—The Local Tradesmen's Association has written to the District Council hoping that it will not pledge itself to any scheme of electric lighting or electric traction before giving the ratepayers full information.

Huddersfield.—At the end of last year it was found that it was necessary to extend the buildings and put down additional plant. At the beginning of the year the Committee placed orders for four Lancashire boilers and two 600-unit plants, to enable the works to successfully supply the demands of additional consumers. Unfortunately, only the boilers are ready for work; the first of the generating plants is not yet delivered, although it should have been completely finished and running by October 15th. Owing to the delay in obtaining this generating plant the Committee have been compelled to defer extending the mains to several districts from which applications have been received. Notwithstanding these retarding influences, the demand still shows a very large increase, as will be seen from the following figures:—

Number of consumers connected—

November, 1894	... 199	...	Increase.
„ 1895	... 252	...	53
„ 1896	... 356	...	104
„ 1897	... 544	...	188
„ 1898	... 751	...	207

Lamps connected—

November,	1894	...	14,460	... Increase.
"	1895	...	18,500	... 4,040
"	1896	...	27,000	... 8,500
"	1897	...	38,600	... 11,600
"	1898	...	50,400	... 11,800

Units of electricity sold for the year ending

November,	1895	...	216,341	... Increase.
"	1896	...	285,566	... 62,225
"	1897	...	417,740	... 132,147
"	1898	...	620,340	... 202,600

In the statement presented last year attention was called to the balance of income over expenditure for the year ending December 31st, 1896, of £434 9s. 1d. At the end of the year 1897 the balance of income over expenditure was £1,184, and it is anticipated that at the end of the present year the balance will be still larger. A number of new transformer chambers have been constructed, and the new mains laid during the year represent an increase of 10,560 yards of high pressure mains, and 6,600 yards of low pressure mains. During last winter in some parts of the town the low pressure mains were overloaded, and it was necessary either to lay more mains, representing a large expenditure of capital, or obtain the consent of the Board of Trade and the consumers to increase the pressure to 200 volts. The latter course was adopted, and during the summer the lamps and appliances fixed upon upwards of 400 consumers' premises have been changed. This alteration will enable the existing low pressure mains to supply four times the energy they were previously doing. The demand for electricity for cooking, heating, and motive power purposes shows, considering the novelty, satisfactory progress, and it is hoped that when these appliances are more understood there will be a very much greater demand.

Kingston.—The Board of Guardians has resolved to apply to the Kingston Corporation for the supply of electric current as and when required.

Kingstown.—Messrs. Port, Sykes & Co., of Dublin, have written to the Township Commissioners, saying that they intend applying for a provisional order. The Commissioners, however, have already obtained an order, and will not sanction the proposal. The letter will be considered by the Electric Lighting Committee.

Kingswood.—The District Council has resolved to apply for power to raise a loan of £2,100 for electric lighting purposes. This is presumably for the purchase of the local undertaking.

Leeds.—At last week's City Council meeting, Mr. Wilson moved the approval of the proposed agreement for the purchase by the Corporation of the Yorkshire House-to-House Electricity Company's undertaking. He said that by the agreement the Corporation would take over the undertaking as from September 1st, so far as capital expenditure was concerned, and as from October 1st so far as revenue account was concerned. Stores, &c., would be taken at a valuation. The purchase money would be paid in stock, bearing interest at 5 per cent., and the Corporation would take over the whole staff and their agreements. The agreement had been signed so lately as the previous day. He believed it was a fair one. The Corporation would have to pay a fair price, and the directors would have a very good case to lay before the shareholders. The resolution was carried.

Leigh.—The Local Government Board have sanctioned a loan for £10,216 for electricity works.

Lincoln.—The Council is to borrow £19,000 additional for electricity extensions, not £10,000 as stated last week.

Liverpool.—The new General Post Office is fast approaching completion. Electricity will be the sole illuminant, the Office of Works itself making the installation.

London.—It is stated that the installation of the electric light at the Colonial Office is practically completed.

Manchester.—In the course of his remarks on election as Lord Mayor, Mr. W. H. Vawdrey said that the electric light had been in every way a success. It had only been in operation five years, and there were over 200,000 8-candle lamps connected with the electric light stations. The charge for the current was one of the lowest in the kingdom, averaging 3¾d. per unit. Everyone connected with the city deserved the greatest credit. He had no doubt their electric tramway system, when completed, would give every satisfaction to the citizens, and would also produce large annual profits in relief of the rates. The following gentlemen were elected members of the Electricity Committee:—The Lord Mayor, Aldermen Gibson, Griffin, Higginbottom, and Mainwaring; Councillors Anandale, Batty, Bax, Bishop, Bowes, Boyle, Hesketh, Tennison, Lambert, Needham, Phythian, and Mr. Wells.

Mansfield.—After considering its position in regard to the General Power Distributing Company's Bill, the Council has resolved to itself apply for a provisional order.

Marylebone.—A complete surprise was sprung upon the members of the Vestry at the last meeting when Mr. Brooke-Hitching obtained permission to move a motion of urgency. He stated that the Electric Lighting Committee had received information from the very best source that, in view of the refusal of the Select Committee of the House of Commons last session to confirm the provisional order issued by the Board of Trade, the latter would not grant another provisional order. After a full consideration of the question, the Committee had decided to ask the Vestry to instruct the solicitors to take all the necessary preliminary steps with a view to obtaining a private Act to authorise the Vestry to establish works for the supply of the electric light in Marylebone, and to empower the Committee to expend £50 in inserting the usual advertisements for that purpose. Mr. Hitching therefore moved a recommendation to this effect, and after a long discussion the proposal was adopted by 40 to 7 votes.

Merthyr.—A special meeting of the Urban District Council was held last Saturday for the purpose of receiving the report of a committee appointed to consider the application of the British Electric Traction Company, who are already promoting an electric tramway scheme, for a provisional order for electric lighting. The committee recommended that the application be opposed, and that the Council consider the advisability of applying for a provisional order. A long discussion took place, with the result that nearly all the members present, by vote, declared themselves in favour of supporting the application, subject to certain conditions. The meeting was adjourned until last Monday.

Musselburgh.—The Town Council has decided to oppose the application of a London syndicate for electric supply powers, and a Special Committee has been appointed to consider the entire question with the aid of an expert, and advise whether or not to go in for a municipal scheme.

Newington.—The Vestry last week decided to take up the first instalment of £10,000 of the electric lighting loan of £50,000 from the County Council, and to repay the advance by 39 annual instalments, commencing in 1902. It was also resolved to agree with the County Council to set aside a sinking fund to meet the maintenance charges on the electric light installation during the currency of the loan period of 42 years.

Orrell.—Mr. Alderman Jones, of Bootle, has a scheme in hand for supplying the small district of Orrell, lying at the rear of Bootle, with electric light. Each of his 600 houses in the neighbourhood will be electrically lighted; to the smallest cottages he will give two 8-C.P. lamps, to another size three, and to the largest four lamps, the tenants paying 3d., 6d., and 9d. extra per week, according to the rental paid. The streets will be lighted at Mr. Jones's expense by means of 16-C.P. lamps. Mr. Jones's brickworks will be lighted by arc lamps. The scheme will cost £3,000, the plant comprising a Clayton dynamo and a Tangye gas engine capable of supplying from 2,000 to 3,000 lights. The conductors will be carried overhead.

Paddington.—On Tuesday, at the Vestry meeting, Mr. Frank Duttridge, the vestry clerk, read a letter received from the secretary of the Metropolitan Electric Supply Company, Limited, asking, in reference to the conversation, that the vestry clerk and Colonel Barchard, chairman of the Electric Lighting Committee, in respect to whether the company were willing to enter into negotiations for selling to the Vestry their undertaking so far as it related to the parish of Paddington, that the Vestry should send its application in writing, and, if possible, they would state what amount they were prepared to offer the company. The letter was referred to the Electric Lighting Committee to consider and report upon.

On Tuesday the Vestry had a long discussion regarding the unsatisfactory condition of the electric current supply in the borough. A resolution was passed referring the matter to the Electric Lighting Committee to communicate with the company.

St. Pancras.—At the meeting of the Vestry on Wednesday, Dr. Long asked the Chairman of the Electricity Committee when it was intended to proceed with the electric lighting of Queen's Crescent. In reply, Dr. W. Smith explained that the whole of the material had been delivered, but that it had had to be returned because it did not come up to the proper tests in regard to insulation. There was difficulty in obtaining the cable, some of which had been on order for three or four months. With regard to the question raised by Mr. Barnes, the residents in Brecknock Road had applied for a supply of the electric light, but unfortunately the roadway was situated in the Islington district. The Electric Lighting Committee had had an interview with the Islington Vestry on the subject. The latter maintained that they had no power in the matter, and the Committee had therefore applied to the Board of Trade for permission to put up overhead wires to supply the houses which were located in St. Pancras, whilst the roadway was in Islington.

Poplar.—The Board of Trade have informed the District Board of Works that the time has arrived for them to consider whether the provisional order should be revoked, and asking the Board to look into the matter. Referred to the Electric Light Committee.

The District Board of Works has decided to authorise the surveyor to engage a temporary draughtsman for the purpose of assisting in the preparation of the necessary drawings and specifications for the proposed electric light station buildings.

Port Talbot.—The railway and docks works here are in a very advanced stage of completion. There is a complete system of electric lighting for the docks.

(*Continued on page 749.*)

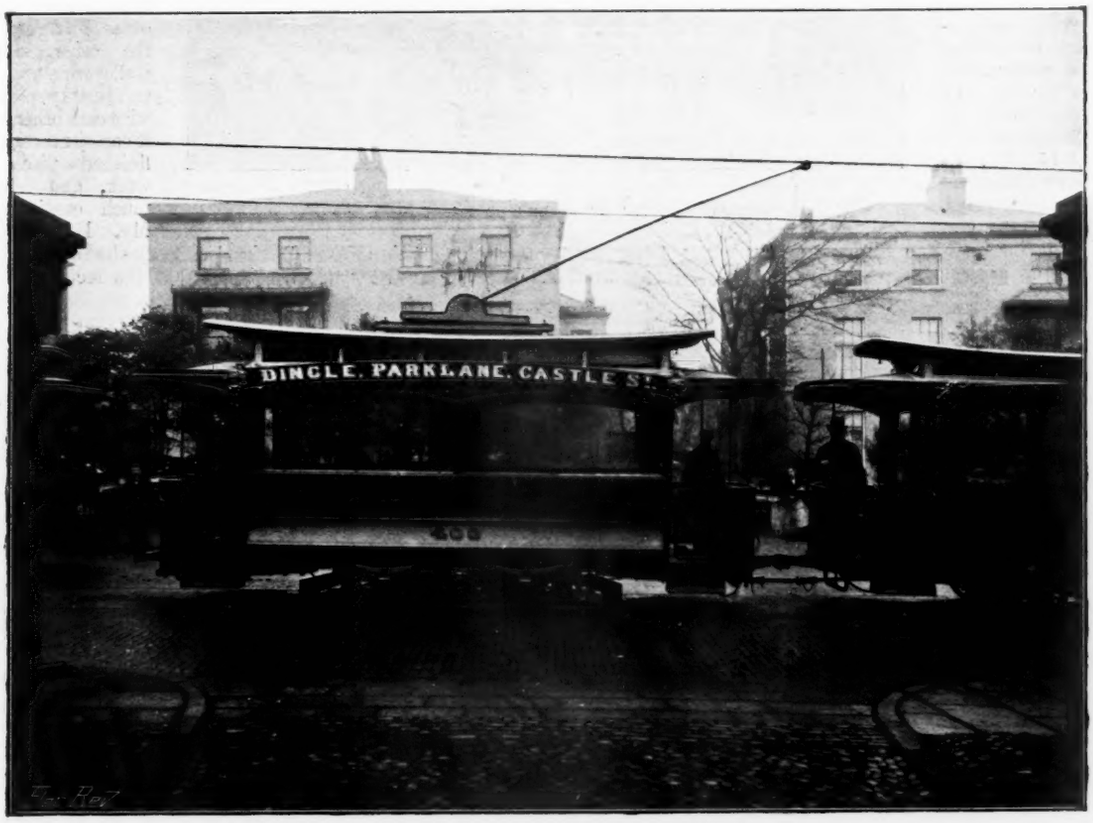
LIVERPOOL CORPORATION ELECTRIC TRAMWAYS.

The first portion of the experimental electric lines of the Liverpool Corporation has been completed and opened for public traffic. This is a fact of more than average interest, because the system is remarkable for the unusual amount of experimenting that has been undertaken. In a mere matter of length the tramway which has been equipped is comparatively unimportant. Roughly speaking, the section consists of about two miles of track; with the addition of a branch line to Prince's Park now under construction, the system will be a little over three miles in length, and will complete the first stage in the introduction of electric tramways into Liverpool. Despite the limited length of the track, the undertaking is of some magnitude in other respects, the rolling stock comprising over 30 electric cars.

Down to September, 1897, the whole of the tramways in Liverpool were owned by the Liverpool United Tramways and Omnibus Company, which had leased the lines from the Corporation. The complete system was then acquired by the Corporation for £567,875, which was equivalent to £12 15s. for each £10 share, the lease having an unexpired term of 18 years.

Previous to the lines being taken over, a Tramway Committee had been formed to inquire into and report upon the best means of improving the service. It had the assistance of a series of preliminary technical reports from Messrs. Bramwell & Harris, Mr. F. S. Pearson, of New York, and Mr. Cunningham, of Montreal; moreover, a joint deputation from the Tramways and Lighting Committee visited the Continent to examine into the various systems in operation, and finally came to the conclusion that the overhead method was best adapted for Liverpool. Before becoming committed to a large scheme, however, it was decided to lay down an experimental line from the centre of the town to one of the southern suburbs. The late Dr. John Hopkinson was called in to advise the Corporation, and the construction of the present system was commenced in June last.

The line commences in the centre of the town, close by St. George's Church, passes down South Castle Street, and round three sides of the General Post Office—which has called forth some interesting overhead work—along Park Road to the Dingle, which is the present terminus of the line. About half-way the system branches off to Prince's Park, this being the section which is not yet completed.



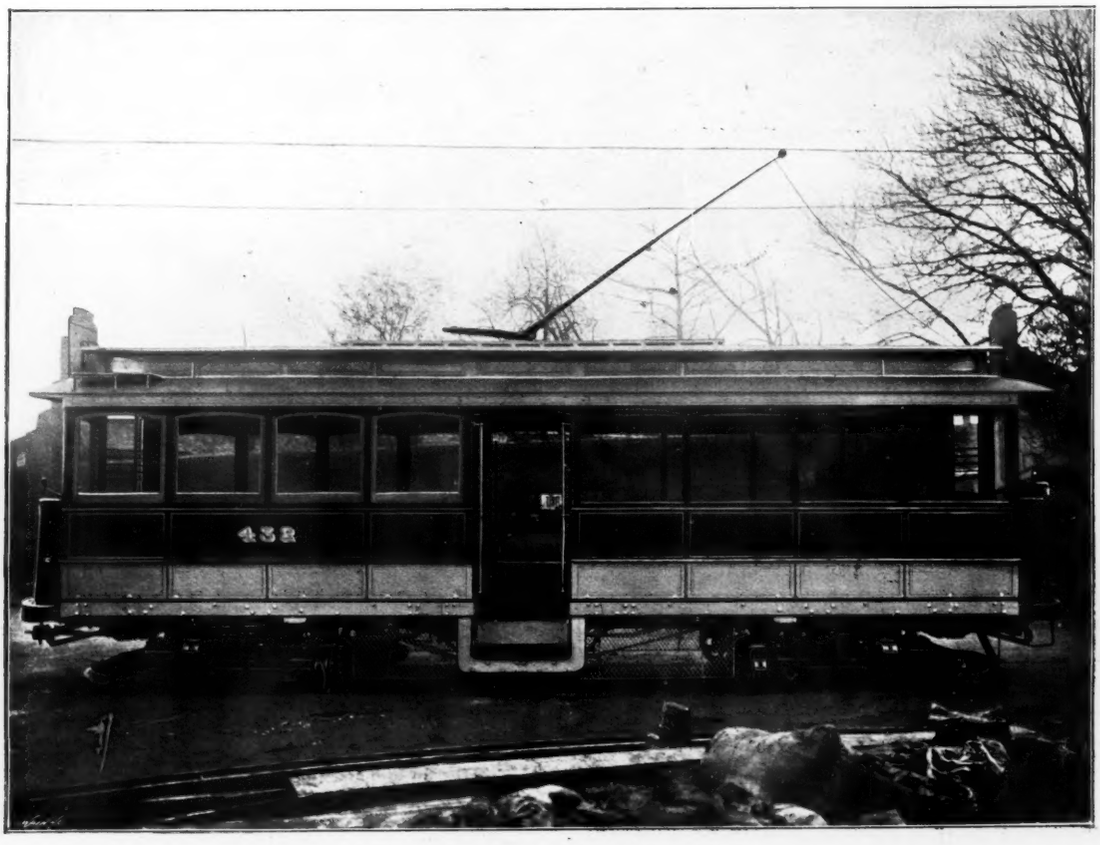
Car with Trailer.

The route is not a specially difficult one. Upon leaving the car sheds at the Dingle end of the line, a gradient of 1 in 25 is encountered. Beyond that it is fairly easy running until within 200 yards of St. George's Church, when there is an ascent of about 1 in 30. The track has been laid throughout by Messrs. Dick, Kerr & Co., a heavy type of rail, weighing 100 lbs. per yard, being employed. There is nothing unusual in the method of laying the track, the rails being laid on concrete. They are bonded together by means of Chicago crown bonds. It is not unlikely that bonding may be superseded on the new lines by the Falk system of welding the rail joints.

The overhead work is of an interesting character, it con-

sisting mainly of the span-wire suspension, relieved at one or two places by double-arm bracket posts. Side posts, placed some 40 yards apart, support the trolley wire through the medium of steel span wires, but at intervals rosettes are attached to the walls of buildings. The use of wall rosettes in the case of Liverpool is interesting, because for the most part the buildings are old, but any fear as to stability of these has been quite dispelled by the tests which have been made. A somewhat heavy insulator of the Aetna type is used. Two kinds of poles are employed, one being single section, and the other built up of two sections. The first type weighs about 950 lbs., and is drawn at one end to a tapering point. The second type, which is built of two sections, weighs about 1,300 lbs., and is of a somewhat ornamental character, the bases being cast to drawings selected from competitive designs. The posts are painted grey, and consequently are not especially noticeable. They are occasionally used to carry a lantern in which an incandescent gas burner is placed. The most effective portion of the overhead work is that passing round the post office: it is a bad S curve, and has necessitated much ingenuity on the part of the contractor for the overhead work. The drawing reproduced shows the method in which the trolley wire is supported at this point; the main bridles are made of two pieces of 7/12 wire, one wire being nozzled off at each ring, and the other running straight through the rings from one hanger to the other. The trolley wires are kept perfectly parallel with each other, and it constitutes a most finished piece of work, and reflects much credit upon Mr. Higginson, who, representing Messrs. Blackwell & Co., has had charge of the overhead construction. We believe that the section of the line to which we have just referred elicited warm expressions of approval from Major Cardew, the Board of Trade inspector. One of the most notable features of the over-

View of Car Sheds.

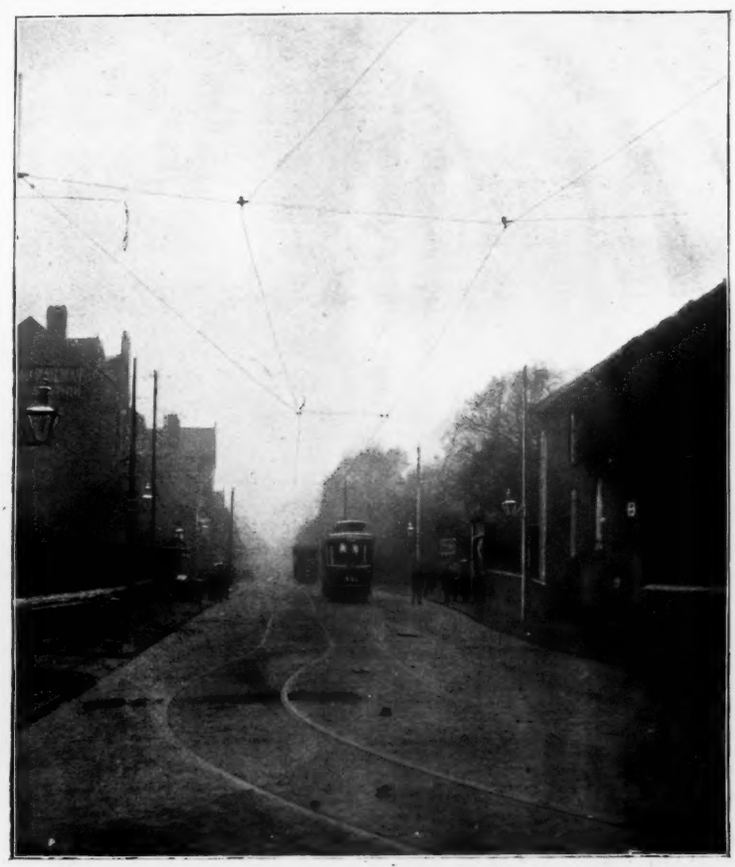


View of American Car.

head work is the absence of guard wires. It has been a little unfortunate for overhead tramways previously erected in this country, that in order to give security to telegraph and telephone wires, they have been compelled to adopt guard wires throughout the system. This imposed a special disability upon span wire methods, for in addition to an extra wire above the trolley, it meant a special set of wires to support it. The practice that obtains a good deal on the Continent with regard to overhead telephone and telegraph wires is that they are only permitted to cross the streets at certain fixed points. Under such conditions it becomes a comparatively simple matter to prevent them coming into contact with a live trolley wire. In this country telegraph and telephone wires cross and recross the streets so many times that it has usually been found necessary to carry guard wires throughout the system. They have been displaced on the Liverpool lines in the most ingenious manner. At points where wires are contiguous a narrow strip of wood is clipped on to the trolley wire. The manner in which this is done will be seen from the details of the guard.

Accumulator Room.

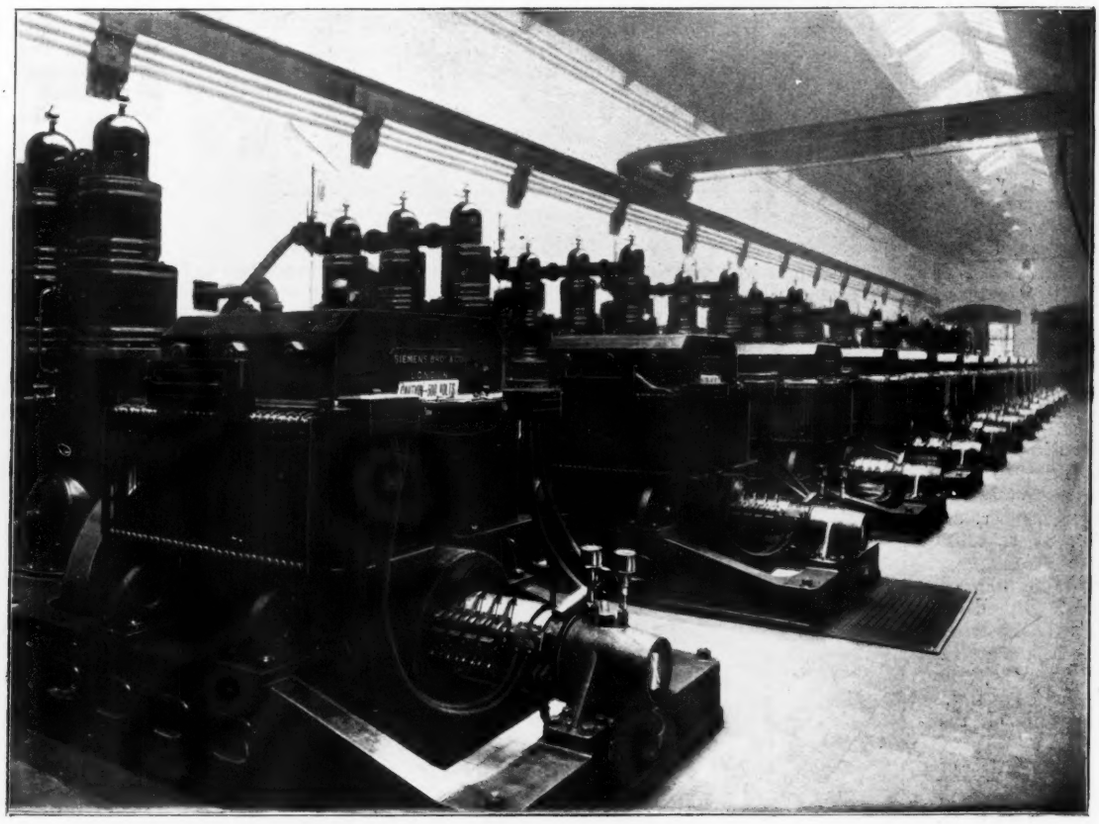
This form of guard suggests heaviness, and no doubt does impose an additional strain upon the supports, but it can be scarcely gainsaid that it is vastly better than a double system of overhead wires, which is what the ordinary guard method means. Probably the future extensions will be carried out on the side bracket system, but the illustrations which we reproduce show that very little can be urged against the appearance of the overhead wires in Liverpool.



Street View at Dingle.

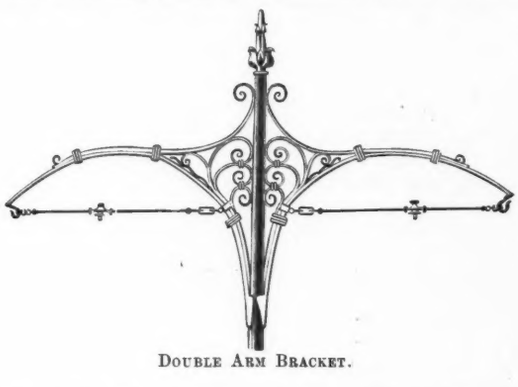
The experimental portions of the scheme is chiefly shown in the type of cars, and how widely they differ in appearance will be seen from the illustrations. The rolling stock comprises 15 motor cars and a like number of trailers, which have been made on the Continent, and consequently reproduce some of the features of Continental design. The motor cars, as far as electrical equipment is concerned, differ only in detail with the practice obtaining in this country and in America. They are equipped with two motors, series parallel controller, and the usual emergency switches. The controller possesses a feature similar to that in the latest form of Westinghouse controller, that is, effecting an arrangement of motors which exert a breaking effect on the cars. The handle is brought back to its starting position, and then gradually reversed, and the motors becoming short circuited act as generators and exert a braking effect according to the amount of resistance inserted. The trailer is in addition provided with an emergency brake of the electro-magnetic type, this being effective only when the trolley is in position. These cars were supplied by Messrs. Schuckert. Generally speaking, the motor car and the trailer will be used in pairs, but no doubt the state of the traffic will govern this. The second type of car is of the double bogie type, and is not unlike that employed on the Glasgow tramways. There are 15 of these, and they are each 34 feet in length. They are divided into two compartments, entrance being obtained in the middle of the car. One compartment is reserved for smokers, and is not provided with windows, while the other compartment is well upholstered and handsomely fitted. The bodies are mounted on Brill trucks, which have 30-inch driving wheels and 20-inch trailing wheels. The cars are fitted with angle iron buffers, extending from side to side of the car. The draw bars are fitted with double acting draw and recoil springs, the draw heads being so arranged that, by withdrawing a pin, the head drops behind the iron buffer. The number of passengers carried by this car is 40. The electrical equipment is

of Messrs. Dick, Kerr & Co.'s standard type, which has been usually employed by them on tramways with which they have been associated. It is that comprising the well-known Walker system, the plant being manufactured under the patents and to the designs of Prof. Sidney H. Short. On each car are two four-pole motors of the 33 S type, with 6-turn windings. The frame consists of two semi-cylindrical castings, the pole pieces being laminated, thus reducing the amount of copper in the field coils, and probably reducing the current required for field excitation. The bearings are carried through the motor casings, which has the effect of preventing waste oil getting into the motor case. Steel gearing, completely enclosed in an iron case, is employed. The method of suspending the motor on the car frame is somewhat interesting. At that end which is away from the axle the motor is suspended on a cross bar, which rotates on its own axis. At the axle end of the motor spiral springs are provided, which give a cushioning effect. It is claimed that this method of suspension minimises the hammer-blow effect so frequently experienced on rolling stock. The controllers on these cars are of the solenoidal series parallel type. Solenoids consisting of spirals of asbestos-covered flat copper ribbon are placed between the sections. At the moment of breaking contact these solenoids are energised, thus creating magnetic lines of force, which blow out the arc. A reversing cylinder enables the motors to be short-circuited, thus acting as an emergency brake. The trolley of the pivotal type is of the usual American character. Perhaps the most interesting feature of these cars is the use of an air brake known as the Standard type. An air compressor is geared to the axle, and is automatically put in and out of action by the variation of the air pressure. The braking power is applied through a cylinder which is controlled from the end of the car. The cylinder acts through a rod on the equalising lever placed at the middle of the car, by which the brake shoes are applied. The connection between the lever and the brake cylinder is a flexible one. In the cylinder is a hollow piston 2 inches diameter, and at the bottom a push rod $1\frac{1}{8}$ inch in diameter is stepped. The rod is fixed at a certain predetermined point on the equalising lever to give the braking power required. When the lever is pulled forward by means of the hand brakes, the rod slides forward from the bottom of the hollow piston, and upon the release of the hand brake it returns to its normal position. When the air brakes are applied the piston moves forward and carries with it the push rod which is stepped at the inner end of the hollow piston. There is thus a perfectly free connection between the brake rigging and the brake cylinder, so that when the hand brake is applied all the power-brake mechanism remains at rest, with the exception of the push rod which adds no appreciable friction in applying the hand brake. An air reservoir is provided as part of the equipment of sufficient capacity to store sufficient air for even the most inordinate demands. The controlling stand contains a pressure gauge in plain view on the top, and the working lever operates without perceptible effort.



General View of Paradise Street Station, showing Tramway and Lighting Plant.

The car sheds, which are illustrated, give a fair idea of the magnitude to which the electric tramways will reach. There are 10 tracks, each of which are provided with pits to give access to the under portion of the cars. An interesting



Double Arm Bracket.

feature of the sheds is that the 10 tracks all run into one, which has obviously necessitated some very special track work. A travelling platform at the rear end of the sheds, which will be eventually worked by a motor, will carry cars to another pair of rails which run alongside the car shed, and are connected to the street rails.

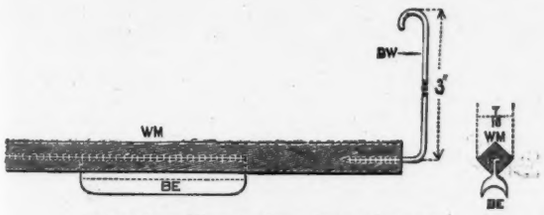
The power plant is erected in one of the lighting stations at Paradise Street. It consists of three Willans-Siemens sets of 300 H.P. each. The dynamos are of Siemens well-known type, shunt wound with drum armatures; they are excited from the station bus bars, and until the exciting switch is closed it is impossible to operate the dynamo switch. Working in parallel with the dynamos is a large battery of E.P.S. accumulators; it is unusually powerful, and could give 1,000 amperes for five minutes, if necessary. The switchboard is simpler than one usually finds in a tramway system. An automatic circuit breaker protects the feeder circuits, and a similar device is employed to protect the battery; the dynamos are, however, supplied with fuses. There are the usually recording instruments, and a special panel is provided to carry out the specified tests of the Board of Trade. An interesting feature is the employment of a booster, one side of which boosts up the feeder current, the other side being employed to prevent fall of pressure in the return circuits. The plant feeds into the line at two points, one near the power house, and the other near the end of the line.

The whole of the scheme has been carried out to the plans of the late Dr. John Hopkinson, under the personal supervision of his partner, Mr. Talbot; Mr. Brodie, the city engineer; and Mr. Bromley Holmes, the city electrical engineer. To these gentlemen we are indebted for assistance rendered in compiling the foregoing details.

The following are the contractors chiefly concerned :—

Cars, equipment, rails and track work	Messrs. Dick, Kerr & Co.
Cars and equipment	Messrs. Schuckert.
Overhead equipments, posts and rail bonds	Messrs. R. W. Blackwell & Co.
Engines	Messrs. Willans & Robinson.
Dynamos	Messrs. Siemens Bros.
Accumulators	The Electrical Power Storage Co

The system was formally opened on Monday last for regular traffic. The service is being carried on by motor



W M, wood moulding; B E, brass ear; B W, brass wire.

WIRE GUARD.

cars and trailers combined. Fares on the motor car (this being the non-smoking car) will be 2d. for the complete journey, and the fares in the trailer car (this being the smoking car) will be 1d. throughout the route.

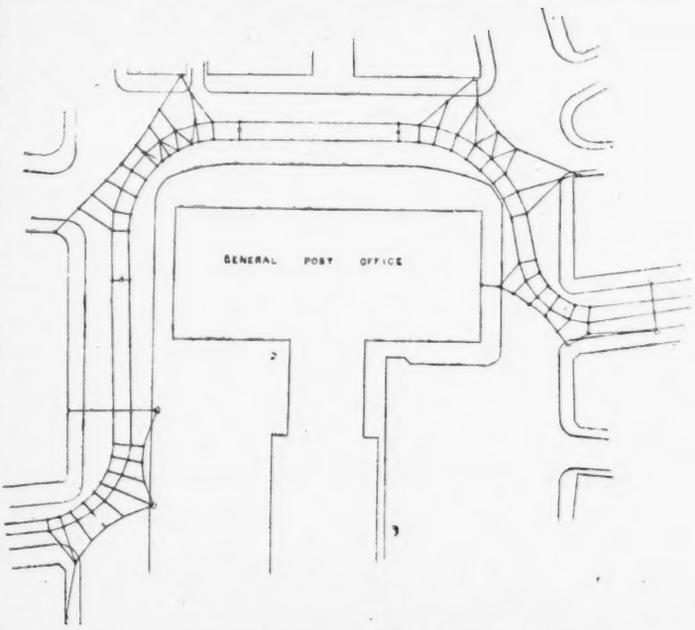
The service is a four minutes' one during the busiest portion of the day. The cars stop at the end of the principal streets only, the average distance apart being about 200 yards, these stopping places in each case being marked by painting a portion of the nearest available tramway column on each side of the street with a white band.

The Royal Society.—Among the papers read yesterday afternoon was one by Prof. Smithells and Messrs. H. M. Dawson and H. A. Wilson, on "The Electrical Conductivity and Luminosity of Flames containing Vaporised Salts."

ELECTRIC LIGHTING NOTES.

(*Continued from page 744.*)

Provisional Orders.—The *London Gazette* for November 11th contains notices of applications for provisional electric lighting orders being made by the municipal authorities in the following districts:—Castleford, Lewisham, Ilkeston, Keighley, Mirfield, Mexborough, Erith, and Glossop. The Electric Works Company's application for an order for Walton-on-Thames and Weybridge is also filed.



LIVERPOOL: METHOD OF SUSPENDING WIRES ON CURVES.

The issue for 15th inst. contains notice of applications being made by the Darfield Urban District Council, Wednesbury Corporation, Bournemouth Corporation, Newcastle-under-Lyme Corporation, Ryde Corporation, Brentford District Council, Winsford District Council, Teignmouth District Council, Vestry of St. Matthew, Bethnal Green. The Devonport Corporation Tramways Bill notice appears in the same issue.

Rathmines.—A Local Government Board inquiry was held on 7th inst. into the Commissioners' application for a £50,000 loan for electric lighting. Mr. Robert Hammond gave an outline of the scheme.

Richmond (Yorks).—The Town Council is watching experiments in northern towns with the view to adopting electric lighting.

Rochester.—Messrs. Martin, Earle & Co., have just completed the introduction of the electric light and a system of electrical communication at their cement works at Wickham, Rochester. This has been carried out by Messrs. A. E. Bennett & Co., of Streatham. There are on the works 12 arc lights of about 2,000 C.P. each, and 200 glow lamps of 16 C.P. The plant includes a compound dynamo, giving 300 amperes at 110 volts pressure. Most of the cables are carried on pitch pine poles, 35 feet high. About 9 miles of wire, and 2,000 English-made insulators have been used in the installation. The switchboard is of polished slate, 1¼ inch thick. It has been specially designed by Mr. Bennett, A.I.E.E. Bells and engine room telegraphs are fitted to all the mills.

Slough.—The Urban Council on Monday empowered the Lighting Committee to engage an electrical engineer, with a view to introducing the electric light.

Southampton.—On 11th inst. there was a brief failure in the supply of current for private lighting.

Southgate.—The District Council has resolved not to consent to the proposed applications by companies for electric lighting provisional orders. Next year the Council will itself apply for powers. It is stated that the Council is not likely to "run blindfold into a scheme of electric lighting which would involve the district in great cost;" in fact, it appears that the Council's present intention is to secure powers, so as to give it a controlling voice in whatever may be done in the future. Evidently it contemplates transference of the order when obtained.

Sutton (Surrey).—The General Purposes Committee, after ascertaining the terms of various electrical experts, recommends the Council to engage Prof. R. H. Smith to advise them as to electric

lighting. The Committee had previously resolved to recommend that the work be not done at the expense of the ratepayers. Mr. Offor, of the Electrical Power Distribution Company, has attended before the Committee with reference to the terms, &c., upon which that company would be prepared to undertake a scheme for the district.

Swansea.—At the Swansea Harbour Trust on Monday, Mr. G. Thomas, the chairman, said that negotiations were in progress for lighting the North Dock by electricity, the suggestion being that the Corporation pay £25 a year towards the cost.

Tobermory.—A public meeting was recently held to consider the electric lighting question. Mr. R. F. Yorke was present, and explained the advantages of electricity. It was resolved to lay the matter before the Burgh Commissioners, and to ask them to consider the feasibility of introducing a scheme.

Tunbridge Wells.—On Thursday last week there was a cessation of the light for about an hour, which, fortunately, did not extend over the whole town. The public lighting was not affected, but the private consumers in High Street and surrounding district suffered inconvenience. The cessation is said to be due to short-circuiting in a sub-station at the lower end of the town, and had nothing to do with the works.

The Local Government Board has sanctioned the borrowing of £15,000 for electric lighting extension purposes, the loan to be repaid in 24 years.

Vaynor and Penderyn.—At last week's meeting of the Vaynor and Penderyn Rural District Council, a communication from the British Electric Traction Company (who are promoting the establishment at Merthyr, Dowlais, and Cefn of an electric light railway), asking whether the Council would object to the company applying for a provisional order to light the district.

Warsaw.—It is reported that a company is in course of formation at Warsaw, with a capital of nine million roubles, to establish works for the manufacture of electric plant on a large scale.

Waterloo.—The Council Chamber and other departments of the Town Hall have been fitted up with electric lighting. The wiring has been done throughout on the distributing board system. The lecture hall has six handsome wrought-iron and copper electroliers, each carrying a number of lamps of 10 and 32 C.P. The Council Chamber, staircase and corridors, have also been well lighted. The installation also includes the lighting of the cookery school, class rooms, the library, and the offices of the clerk and surveyor. The contractors were Messrs. Waring & Gillow, Limited. Mr. H. Ellis Thompson acted as resident manager of Messrs. Donnison, Berlyn and Sillem. The specifications for the whole work were prepared by Mr. Spencer Yates, the Council's surveyor.

Wednesbury.—A special meeting of the Town Council has been convened for this (Friday) evening to consider whether to apply for a provisional order.

Whitechapel.—The District Board of Works has approved the committee's recommendation, stated in the Electrical Review last week, *re* site for municipal electricity works.

Whitehaven.—The electric light is being installed in the Whitehaven and West Cumberland Infirmary, the work being carried out by Messrs. D. Burns & Co. The borough electrical engineer, Mr. J. Shanks Brodie, C.E., has oversight of the installation.

Winchester.—The Board of Guardians has decided to accept the lowest tender submitted for the electric lighting of the workhouse.

Windsor.—Among recent improvements carried out at Windsor Castle, is the fitting up of the Queen's private chapel with the electric light.

The Town Council is considering the question of improving the street lighting by means of a number of arc lamps.

Woking.—At the last District Council meeting, Mr. Clinton called attention to the unsatisfactory character of the electric light, and on his motion a committee was appointed to inquire into the cause of the failures and take what steps they considered necessary to prevent the town from being left in total darkness.

On 8th and 9th insts. there was a failure in the private electric supply.

Wolverhampton.—At the annual meeting of the Wolverhampton Town Council on Wednesday last week, Alderman C. T. Mander, chairman of the Lighting Committee, moved the annual report of that Committee, and took occasion to reply to some adverse criticisms which had recently been made on the policy of the Committee. It was suggested, he said, in certain quarters that the Committee were not at all satisfied with the generating station and system. That was not so. The Committee were perfectly satisfied that their system was a good one. The chairman then explained what the present alteration was, and how it became necessary and desirable. What they proposed to do would cost something in the first year, but it would result in greater profits or reductions to consumers. Their original contract for £30,000 odd was for turning out a matter of 10,000 8-candle-power lamps. In 1895 they had 7,236 lamps to supply the power for; to-day the number was 16,718, whilst there were 1,409 lamps on order which were not yet connected, so that by Christmas they would have over 18,000 lamps. The undertaking was constantly growing, and they were bound to keep ahead of it. The question had been asked whether it would cost the consumers a lot of money to change from one system to the other? He now explained that it would cost them nothing. The scheme was a sound commercial success at the present time, and would be still sounder in the future. With regard to the gas company, he thought it was an open question whether it was not worth the while of Council at the present time to buy the gas concern, though they had so much "on their plate," he could not recommend the purchase, which ought to have been done some years ago. The report of the Lighting Committee was adopted.

Yarmouth.—The Council has accepted the tender of Messrs. Gray & Palmer (£29 odd) for lighting the shelters at the Jetty by electricity. The tender of Messrs. Bateman & Co. for 1,000 tons of coal of the same quality as hitherto supplied by them at 14s. 6d. per ton has been accepted, also that of Messrs. W. Cory and Sons, Limited, for 1,000 tons of Derbyshire nutting steam coal at 12s. 6d. per ton.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Austria.—The Union Electrical Company, of Berlin, has just acquired the Brux steam tramways for the sum of 970,000 fl., with the view of converting the same into electric lines.

Ayr.—The Town Council on 14th inst. considered a report by Mr. J. E. Winslow, of 35, Parliament Street, London, on the proposed electric tramway system. He advises the overhead trolley system as the only one financially possible. He thinks that the Corporation in their scheme should arrange for the laying of a single track with passing places from Prestwick Cross to Main Street, but through Main Street, High Street, and Alloway Street a double track should be laid. He recommends that the standard gauge be adopted, and that the cars be of sufficient width to have cross seats inside as well as on the roof, thus giving increased carrying capacity. He estimated that an expenditure of £44,460 would enable the Corporation to obtain a first-class and efficient tramway. This is for four miles of route. The expense of building the line from St. Leonard's Church to Burns's Monument would be £13,350 additional. The Bill Committee of the Council which has had the report under consideration, adopted the recommendation as to the track and size of car. They disapproved of the suggestion as to the construction of a line from the railway station to the esplanade, and adhered to the line resolved upon from Burns's Monument to Prestwick Cross. In view of the resolution of the Council to construct a tramway, the Bill Committee has been instructed to take whatever steps are necessary to oppose the application by Messrs. Drake & Gorham to the Light Railway Commissioners for power to construct a light railway from Ayr to Monkton.

Bangor.—The Drake & Gorham Electric Power and Traction (Pioneer) Syndicate, Limited, has a scheme in hand for the promotion of a tramway system between Bangor and Donaghadee. The scheme will provide tramways in nearly every part of Bangor, but the main line will run along the coast road to Donaghadee, a route which is very largely availed of by visitors during the summer. As soon as the sanction of the local bodies is obtained, the promoters will rapidly take the work in hand with a view to having the tramway in operation in the early part of next season.

Birkenhead.—A ratepayers' meeting on 11th inst. sanctioned the promotion in Parliament by the Corporation of a Bill for the establishment of electric trams in the borough.

Bristol.—A private meeting of the Sanitary Committee was held on Monday to consider a question which had arisen in connection with the scheme which will equip Bristol with electrical tramways. The city has a few wide streets and a good many narrow ones, and it was necessary, says the *Bristol Mercury*, to come to some decision as to what difference should be made in the arrangements for carrying the overhead trolley wire in various thoroughfares. The Committee, after considerable talk over the matter, came to the conclusion that in streets not less than 40 feet wide between the kerbs, centre posts—in the middle of the road instead of the side standards—should be used, while in thoroughfares of less than that width the trolley wire should be supported by side posts with brackets. Mr. S. White, the secretary of the Bristol Tramway Company, with the engineer, Mr. Edwards, subsequently had an interview with the Committee, and were informed of the decision that had been arrived at. The company have to submit detailed plans of the various parts of their new works, and presumably will be guided in their details by the Committee's resolution. The representatives of the company were also asked to consider whether the company would share with the Corporation the expense of putting down a subway in Bath Street and Philip Street for the purpose of containing the cables of the city electrical works and those of the tramway undertaking. They will, therefore, have this under consideration as well.

Camborne and Redruth.—There is a proposal on foot to lay a tramway between these two places on a 3 feet 6 inches track. It is stated that electricity will probably be the motive power. The line will traverse the main road at Camborne, and will convey both passenger and goods traffic.

Coatbridge and Airdrie.—The Board of Trade last week heard objections to the order passed by the Light Railway Commissioners authorising the British Electric Traction Company to construct and work a light railway between C

Mr. Courtenay Boyle, permanent secretary to the Board, presided. The objectors were the North British and Caledonian Railway Companies. It was expected that opposition would also be given by the Corporations of Airdrie and Coatbridge, but at the outset Mr. Ram intimated that an arrangement had been come to between the promoters and the Corporation, and the local authorities now supported the order. Mr. Kennedy, Parliamentary agent for the New General Traction Company, who had proposed a competitive scheme which it was intended to ask Parliament to embody in an Act, stated that his objections would be stated practically by the railway companies.

Cork.—It is anticipated that the supply of electric current for lighting will be available in December. The electric tram scheme is rapidly approaching completion. Conductors are being trained as to the method of driving the cars. It is expected that the cars, too, will also begin running next month.

Dollymount and Howth.—The contract surveys in connection with this undertaking, sanctioned by Parliament a few months ago, are now completed. The line will be a continuation of the present tram system to Dollymount, from which point it will pass along the shore for about a mile, joining the county road near Kilbarrack. An embankment will be constructed over this portion, with a concreted pathway for pedestrians and bicycles alongside. For the remainder of its length, says the Dublin *Daily Nation*, the line will be on the right-hand side of the county road (which has an average width of 50 feet) and will consist of a single line, with frequent passing places, except that the portion from Howth Church entrance to the terminus at the East Pier will be altogether doubled and the roadway paved. The total length will be about 5¼ miles. The surface is a dead level, with only one slight gradient, and the electricity required will be generated in the existing power station at Clontarf. It is intended (for the first time in Ireland) to adopt ½d. per mile fares on this line, making a total charge of 5d. from College Green to Howth East Pier, a distance of 10 miles. The rolling stock will be built in Ireland. It is hoped to have the line open for traffic about June 1st, 1899.

Doncaster.—Last week the town clerk reported an interview with a representative of the British Electric Traction Company, Limited, in which he stated that the company were about to apply for powers to institute trams for Doncaster, Balby-with-Hexthorpe, and Wheatley.—It was recommended that application be made to the Light Railway Commissioners for powers to provide electric trams, the routes to be, generally, the present six 'bus routes.

Dublin.—Building operations for the large electric power station at Ringsend for the Dublin Electric Tramways Company are proceeding. The work of laying the electric tramlines of the city is also making progress. It was thought that the Donnybrook line from Nelson's Pillar to Donnybrook would be opened during this week, and the North Circular Road line from Nelson's Pillar to the Phœnix Park may be opened by the end of the month.

Glasgow.—The Gorbals Ward Committee last week resolved to ask its representatives to oppose the extension of the overhead system on the South Side and other parts of the city, but to advise that an opportunity be given for the trial of other modes of electric and other motive power.

It is stated that the working of the trolley on the Springburn section has resulted in a saving of 3d. per mile on the working expenses, and this is understood to have inclined the Tramways Committee to recommend the equipment of an electrical section from Glasgow Cross to Govanhill.

Councillor Stevenson has written to Mr. Young, tramways manager, suggesting the trial of the conduit system upon the Govanhill section.

Gravesend.—The Town Council after a lengthy discussion on the question of electric tram schemes for the district, has decided to take no action until the expiration of the lease of the present tramway company.

Hastings.—The Town Council has resolved to appoint a Consultative Committee to act with the town clerk and borough engineer for the purpose of carrying into effect the resolution passed on November 4th, 1898, on the subject of the proposed application to Parliament for powers relating to tramways, and report from time to time.

St. Helens.—An interesting experiment in municipal enterprise is now being made in the Lancashire borough of St. Helens, whose extensive area and the contiguous district contain nearly 200,000 inhabitants. The experiment, says the *Liverpool Mercury*, takes the form of an effort to place the working of the tramway system under the joint proprietorship of the Corporation and private enterprise. The Corporation will generate and supply the electric power, and the company will provide the vehicles and working staff. The Corporation obtained Parliamentary powers to establish electric stations both for light and energy. They also obtained powers to lay down a comple'e network of rails through the whole district, to be worked by electricity. Instead of managing the tramways themselves, the Council have preferred to delegate this duty to men with practical experience. They have therefore granted a lease for 21 years to a company, who will undertake to provide an efficient service of cars, and to run at frequent intervals at cheap fares. On their side the Corporation undertake to lay down rails of the most approved type, to equip the lines on the trolley system, and to supply electric energy at a fixed charge, namely, 2d. per unit for the first 400,000 units, and reducible to 1d. per unit when the full quantity of power is consumed. Some of the advantages claimed for the arrangement are that the Corporation will be assured of a fair return on the capital they have invested, and a profitable use of their electric plant, so that they will secure a good return to the ratepayers, without incurring any responsibility for the actual working and conduct of the tramway business. The company, on their side, anticipate material advantage, because the charge for electric power under the lease will be far less than the cost of the steam or horse haulage, which they now use. The future extension of the system, they also anticipate, will bring St. Helens into direct connection with Liverpool at lower fares than are now charged by the railway companies.

Hull.—Mr. Edward Nicolls, the contractor for the relaying of the roads at Hull in connection with the construction of the electric tramways, has filed his petition and been adjudicated a bankrupt. We understand that the Hull Corporation is itself at the moment pushing forward the preparation of the tramway track.

Salford.—The electrical engineer has submitted his estimate of the cost of the trolley line equipment for the Salford tramways as follows:—Poles, £14,000; trolley lines, £8,000; telephone and test wires, £4,000; section pillars, £2,000; bonds, £4,000; total £32,000. It was decided to submit a copy to each member of the Electrical Committee, to Mr. Hopkinson, and to the borough treasurer. It was decided to borrow £200,000 for the laying of the new tramway lines.

Speed of Electric Cars.—The Board of Trade will hold an inquiry on 23rd inst. with reference to the application of the Dublin Tramways Company for an increase of speed on the Southern District line.

The Dublin Corporation thinks that seven miles an hour should be permissible in the ordinary open streets, five miles in congested streets, and four miles an hour at the facing points, where there was a great deal of danger.

The Clontarf Commissioners will allow a speed of 10 miles an hour between Annesley Bridge and Dollymount. The company wanted to increase to 12 miles.

Swansea.—The negotiations which have for months past been proceeding between the British Electric Traction Company and the Swansea Corporation with reference to the street widenings necessary for the provision of additional passing places have been brought to a head. Without imposing any conditions as to how or where the money shall be spent, the Traction Company have agreed to pay over to the Corporation treasury a sum of £5,000, the Corporation, on their past undertaking, to give the company such facilities for conducting their traffic as the Corporation would themselves provide were they carrying out the undertaking.

There is just now a revival of the report published some months back that the Electric Traction Company are negotiating with the Swansea and Mumbles Railway Company for the acquisition of the line and the adoption of electrical power.

Withington.—At a recent meeting of the District Council the Parliamentary Committee reported that the Moss Side Council had resolved to give notice of their intention to apply for an Act of Parliament for the working of the tramways in their district, and the committee recommended that the Withington Council should promote a similar Bill in the ensuing session. The committee also resolved that in the event of an arrangement being come to with the Manchester Corporation to work the tramways, the Bill should not be proceeded with. The clerk was instructed to arrange for an interview with the Tramways Committee of the Corporation to discuss terms upon which the Corporation will lease the Withington trams. The clerk is to render an account of the expenses incurred in obtaining the electric lighting order, to the Manchester Corporation.

TELEGRAPH AND TELEPHONE NOTES.

Cable Rates.—In an article dealing with the cable rates charged by the Eastern Extension Telegraph Company, published in the *Investors' Review* for October 21st, the following paragraph appears:—"One striking feature, however, is brought out by our examination of this question, and that is, the high rate charged to India compared with other important places in the world. This rate is in the hands of the Eastern Telegraph Company, and so does not fall under the control of the Eastern Extension Company, whose system only commences at Madras on the eastern coast of India. When one considers that the rate to India is still 4s. per word, and that for 1s. 6d. per word more one may communicate with China, or that for 9d. per word more with South Australia, the Indian charge appears oppressive. No doubt the high rate is partly traceable to the fact that 'India' means any place in India, and that the charges of the Indian Government for the use of the landlines represents a part of the 4s. per word. Even allowing for that, the charge appears high when it is found that the rate to Alexandria—more than half way—is only 1s. 7d. per word, while to go almost as far again—to New Zealand—only 5s. 2d. per word is required. The volume of messages must be all in favour of India, and the huge business done with our great dependency should certainly lead to an expansion in the Eastern Company's earnings sufficient to soon recoup it were it to grant a liberal reduction in its present cable rate." We are glad to notice the remarks concerning the high rates which are at present charged to India, compared with the rates to other important places in the world. We do not, however, agree with the *Investors' Review* in tracing the cause of this to the charge of the Indian Government for the use of landlines. A telegram from London to Bombay costs 4s. per word, and the charge per

word throughout India from any one part to the other (with the exception of Burmah) is 2 annas, or, say, 2d. per word. Even were this included in the 4s. rate, it forms a very slight proportion of the total.

Cable Steamer.—Messrs. D. J. Dunlop & Co., of Greenock, have received an order to build and engine a cable-laying steamer of 1,200 tons register for the German Maintenance Company.

Canadian Telegraphs.—We learn from the *Canadian Gazette* that the Public Works Department at Ottawa has been making excellent progress this year on the telegraph line along the north shore of the St. Lawrence, and there is little doubt that the entire line will be completed to Belle Isle, and a short cable laid connecting the island and the mainland before the close of next season. This will be a very great convenience to the shipping interests, as it will enable vessels to be reported at Montreal within a few minutes after they enter the Strait. The cable to the Magdalen Islands has also been put in good order, and the cable to Anticosti Island has been repaired for the first time since 1891.

The City Police and the Telephone.—The Police Committee of the Corporation have recently considered the question of the advisability of connecting the City Police Stations by telephone. The *City Press* recently made inquiries at the head-quarters in Old Jewry, and gathered that the authorities were in no way anxious to possess the advantage of the telephone, as their present system of telegraphic communication was complete and worked admirably. The *City Press* is, however, of opinion that the chief officials of the City force would find a dual system of communication of immense value.

Gutta-Percha Planting in the French Congo.—From the *Politique Coloniale* of October 8th we learn that Mr. P. Bourdarie, who was engaged in a Government mission to the French Congo, took there with him a large number of Wardian cases of India-rubber and gutta-percha plants (*Isonandras*, *Heveas*, and *Castilloas*) for introduction into that colony. It is much to be regretted that in the Straits Settlements and protected native States of the Malay Peninsula, which afford so many natural facilities for the growth of these plants, no steps seem to have been taken to compensate for the wholesale destruction, we may almost say the extinction, of the gutta-percha trees in these districts, to which we have to look almost entirely for our supply of gutta-percha. We learn that owing to the rise in the price of India-rubber some of the coffee planters in Selangor have seriously taken up the subject of planting India-rubber trees, and that there will be several thousands of acres planted by the end of this year.

The National Telephone Company's Defence.—We reproduce the following letter, written to the *Times* by Mr. W. E. L. Gaine, general manager of the National Telephone Company:—"Sir,—In reference to the debate which took place relative to the telephone service in the London County Council on Tuesday last, a report of which appeared in the *Times* of yesterday, I have to ask you, on behalf of the company, to afford me the opportunity of placing a few facts before your readers. It is charged against the company that its service in London is inefficient and inadequate. My reply is that to whatever extent it may be so at this moment is entirely the fault of the London County Council. In May, 1896, the company applied to the County Council for the consent of that body, as required by the Telegraph Act, 1892, to enable the company to place its wires underground—the only solution of the serious difficulties which otherwise beset the company from the use of overhead wires. Prolonged negotiations followed, and finally terms were agreed and embodied in a series of resolutions passed by the County Council on June 1st, 1897. Nothing further remained to be done but to prepare and execute a formal agreement to give effect to the bargain. These negotiations, it will be seen, occupied rather more than a year. It took the County Council nearly seven more months to prepare the draft of the formal agreement, and this document was submitted to the company for consideration on January 29th, 1898. It was then found that two additional conditions not forming part of the bargain had been inserted. These conditions were—(1) That the company should make a wayleave payment to the County Council which would impose a burden upon the company amounting to several thousand pounds per annum, and (2) that the company should reduce its tariffs to an arbitrary scale as fixed by the County Council, which would involve the company in an immediate loss of revenue of upwards of £40,000 per annum. The company considered that the importation of these conditions after more than 12 months had been spent in concluding the bargain was not in accord with good faith. The company replied that, as it had agreed to make wayleave payments to a large number of provincial cities and towns, it was willing to do so in the case of London, but pointed out that, differing from the provincial cities, the County Council was not the road authority, and that it could only do so if the County Council indemnified the company against any claims which might be made by the road authorities in the metropolis, and, as regards tariffs, it respectfully declined to discuss the impossible proposition submitted to it, but offered to agree to fix the company's present tariffs as the *maximum* charges to be made, and to come under an obligation to supply all intending users equally and without undue preference. On May 19th, 1898, the County Council broke off the negotiations. The position may, therefore, be summed up as follows:—Twelve months occupied in negotiations, finally resulting in a bargain being arrived at; further 12 months occupied in preparing a formal document to give effect to the bargain; finally resulting in the County Council withdrawing from it. On the 3rd inst. there were 992 people in London waiting to be joined up to the company's system. As regards the bulk of these, they will have to wait an indefinite time, on account of the difficulties in the way of the company in physically connecting their premises with its exchanges, owing to the want of facilities which it is in the power of the County Council to give. Whether it is or is not desirable to import competition into such a service as that of the telephone appears to the company to afford no reason why the company should be denied facilities for doing its work. Even if competition is set up it must, in the nature of the case, take years before it can meet fully public requirements, and in the meantime the public suffers and blames the company for not doing the impossible. I see that it was stated in the course of the debate that the Highways Committee is prepared to recommend the requisite facilities being given to the company, if the company will concede to London similar terms as to tariffs and wayleave payments as the company has given to Manchester, Liverpool, and other towns. The position of London is not comparable with that of any other town. It covers an area of 634 square miles. The working cost of a telephone system throughout this great area is nearly double what it is anywhere else, and the tariffs must therefore be proportionately higher. At the same time I may add that the company is considering whether it cannot meet the requirements of small users and those requiring a more limited service. It is the intention of the company to invite the County Council to re-open negotiations, and it will not be the fault of the company if a proper arrangement is not come to. Let me give one instance of the treatment to which the company is subjected. When the bargain was concluded with the County Council on June 1st, 1897, the company was allowed to go on with certain portions of underground work which were very urgently needed. Amongst the works authorised is a system of pipes for upwards of 6,000 miles of wires, which the company has laid down in the districts governed by the Holborn Board of Works and the Vestry of St. Giles, all centring upon a large exchange of the company situate at the corner of Holborn Viaduct and St. Andrew Street. These pipes are stopped close to the north-west corner of Holborn Viaduct, and for months they have been lying idle, and so far as can be seen are likely to remain so, because the company cannot obtain from the local authority the permission to carry them across one road and into the exchange. In conclusion, I have only to say that it is not reasonable to blame the company for the deficiencies of its service if proper facilites are refused, and every impediment and difficulty placed in its way."

"Penny-a-Word."—Mr. Henniker Heaton is now advocating a penny-a-word electrical telegraph system for drawing the peoples of the British Empire still closer together.

Religion and Telegraphy.—The *Gazette de France* complains that France is still depending on English submarine cables, and "that in 1887 a convention with a French company was rejected on account of its being headed by militant Catholics." Surely, some other explanation than this can be found!

The Telegraph Wire Export Trade.—Although the returns just issued regarding the exports from this country of telegraph wire and apparatus connected therewith during October are a little more favourable than was the case in September last, there is not the activity prevailing recorded two or three months ago. The exports for the month just ended attained a value of £89,313, as compared with only £35,411 in the preceding month and £47,746 in October last year. Taking the year, however, so far as it has gone, it has been, on the whole, very satisfactory, the exports for the 10 months ending with October having amounted to £936,721, as against only £794,621 in the corresponding period of last year and £699,905 in the first 10 months of 1896.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
West Indies—		
St. Lucia-St. Vincent ...	Sept. 24th, 1898 ...	...
Amazon Company's cable—		
Cable beyond Gurupa ...	June 8th, 1898 ...	...
Bolama-Bissao	June 21st, 1898 ...	Nov. 11th, 1898.
Pernambuco-Ceara ...	Oct. 19th, 1898. ...	...
Saint Louis-Novonha ...	Oct. 17th, 1898 ...	...
Para-Maranham	Nov. 15th, 1898 ...	...
Landlines.		
Saigon-Bangkok	Nov. 9th, 1898 ...	Nov. 10th, 1898.

CONTRACTS OPEN AND CLOSED.

OPEN.

Beckenham.—December 17th. The Urban District Council invites tenders for water-tube boilers, alternators, transformers, pipe work, feed pumps, arc lamps and posts, cables and other street works, travelling crane, &c., &c., for the electric lighting scheme. Specifications, &c., from Messrs. Wilson & Story, 66, Victoria Street. See our "Official Notices" this week.

Blackpool.—Corporation wants tenders for trolleys, wire, &c., in connection with conversion of conduit lines. See our "Official Notices" November 11th.

Dublin.—December 5th. The Dublin United Tramways Company is prepared to receive tenders for the supply of general stores, including car fittings, iron, steel castings, oils, electrical supplies, &c., &c., for the year ending December 31st, 1899. Infor-

mation can be obtained, and patterns seen, at the company's offices, 9, Upper Sackville Street, Dublin, from November 15th to December 2nd. Forms of tender 1s. each.

Dublin.—December 5th. The Board of Control want estimates for engines, dynamos, and wiring for about 100 electrical H.P. at Richmond District Lunatic Asylum. See our "Official Notices" this week for particulars.

France.—November 28th. Tenders are being invited until the 28th inst., by the municipal authorities of Anzin (Nord), for the concession for the lighting of the town during a period of 40 years, either by gas or electricity. Tenders to be sent to La Mairie d'Anzin (Nord), whence particulars may be obtained.

Glasgow.—November 22nd. The Corporation is inviting tenders for the supply and erection of switchboards and instruments for the new electricity works at Port Dundas. Specifications, &c., from Mr. W. A. Chamen, electrical engineer, 75, Waterloo Street, Glasgow. See our "Official Notices" November 4th.

Halifax.—The Corporation wants tenders for meters, transformers, and arc lamps. See our "Official Notices" this week.

Hill of Howth.—November 19th. The Great Northern Railway Company (Ireland) is inviting tenders for the following in connection with their power station to be erected at Sutton, near Dublin, viz:—Lancashire boilers, with or without mechanical stokers, engines, dynamos, pumps, piping, crane, feed heater, and tools; switchboard. Specifications to be seen at the office of Prof. A. B. W. Kennedy, 17, Victoria Street, S.W. See our "Official Notices" November 4th for further details.

India.—November 23rd. The East Indian Railway Company is desirous of introducing electrically-controlled block instruments on their system, and invites proposals from makers only for the supply of: For single line—18 instruments for nine blocks; for double line—80 instruments for 41 stations, and six spare instruments. Particulars from Mr. A. P. Dunstan, secretary, Nicholas Lane, London, E.C.

Middlesbrough.—November 29th. The Electric Lighting Committee is inviting tenders for the supply and erection of Lancashire boilers, and boiler house plant, slow speed steam dynamos and accessories, condensing plant and pipe work, overhead travelling crane, switchboard and instruments, accumulators, supply and laying of cables, meters. Specifications, &c., from the consulting engineer, Mr. Robert Hammond, 64, Victoria Street. See our "Official Notices" October 28th for further particulars.

Salford.—December 1st. The Electric Lighting Committee want tenders for the supply and erection of the following plant for the Electric Light Committee. Section (1) boilers; (2) engines; (3) dynamos; (4) boiler feed pumps, &c.; (5) mechanical stokers; (6) superheaters; (7) economisers; (8) condensers, &c.; (9) steam and water pipes; (10) cranes and weighing machines; (11) tanks, &c.; (12) switchboards; (13) booster. Specification, information, &c., may be obtained from the electrical engineer, Walness Road, Broughton, on payment of £5, returnable as usual.

Shanghai.—The Shanghai Municipal Council invites tenders for a concession for constructing and working about 23 miles of electric tramways on the trolley system in the streets of Shanghai. Plans may be seen and particulars obtained on application to Messrs. John Pook & Co., 8, Jeffreys Square, St. Mary Axe, London, E.C.

Shanghai.—The Shanghai Municipal Council invites tenders for a concession for a period of 30 years for the exclusive right of establishing and working a telephone system in Shanghai. Plans may be seen and particulars obtained on application to Messrs. John Pook & Co., 8, Jeffreys Square, St. Mary Axe, London, E.C. See our "Official Notices" this week.

Waterloo-with-Seaforth (Lancs.).—November 26th. The Urban District Council invite tenders for the supply of 16 electric arc lamp columns and carriers. Specifications and further particulars obtained from Mr. F. Spencer Yates, A.M.Inst.C.E., surveyor to the Council, at the Town Hall.

CLOSED.

Aberdeen.—The following is a list given in the *Contract Journal* of the firms tendering for the supply of meters, service cables, and fuse boxes during the year ending August 31st, 1899, for the Corporation Electricity Works:—House service cable: British Insulated Wire Company, Limited, Prescot; Callender's Cable and Construction Company, Limited, London (accepted); Western Electric Company, North Woolwich; Siemens Bros. & Co., Limited, London; Telegraph Manufacturing Company, Limited, Helsby; W. T. Henley's Telegraph Works Company, Limited, London. House fuse boxes: A. Spark, Aberdeen (accepted); E. F. Moy, Limited, Camden Town, N.W.; Reason Manufacturing Company, Limited, Brighton; British Insulated Wire Company, Limited; General Electric Company, Limited, Glasgow. Electricity supply meters: Penny-in-the-Slot Syndicate, Limited, London; S. Z. de Ferranti, Limited, Hollinwood (accepted); Venner & Co., Westminster, S.W.; General Electric Company, Limited; British Insulated Wire Company, Limited; Premier Electricity Meter Company, London.

Bournemouth.—The following were the tenders sent in for the supply of steel masts for arc lamps for the Square and Pier Approach, Bournemouth, Mr. F. W. Lacey, M.Inst.C.E., borough engineer and surveyor:—

	⅜" metal. Each.	½" metal. Each.
McDowall, Steven & Co., Ltd.	£230 0 0	£245 0 0
John Spencer, Ltd.	190 0 0	*180 0 0

* (Accepted for ½-inch metal).

Bournemouth.—The following is a list of the tenders and schemes for the supply and fixing of a steam pump, donkey pump, and surface condenser for the Council, Mr. F. W. Lacey, borough engineer:—

Goddard, Massey & Warner, for compound condensing plant, high finish	£1,027 0 0
*Do., do., simple condensing engine	*515 0 0
Worthington Pumping Engine Company, compound condensing engine	648 0 0
Do., do., triple expansion condensing	698 0 0
Pulsometer Engineering Company, Limited, compound condensing engine	580 0 0
Tangyes, Limited, simple condensing	530 0 0

*Accepted.

The tender and scheme submitted by Messrs. Goddard, Massey and Warner, for forced draught to existing boilers at Bournemouth pumping station has been accepted at £120 10s.

Hull.—The Electric Lighting Committee on Tuesday accepted the tenders of Messrs. T. Parker & Co, Limited, for switchboards, transformers, and motor generator at £3,630; Messrs. Siemens Bros. for cables, &c., at £10,654 15s; and Messrs. Barker & Aspey (Hull) for pump condensers and steam water pipes at £915 15s. 4d. All the tenders were in connection with the East Hull extension.

Leigh.—The Local Government Board having sanctioned the loan of £10,216 asked for by the District Council for the purposes of electricity works, the Gas, Water, and Electricity Committee of the Council have accepted the following tenders: Mather and Platt, Ltd., Salford (1) for the supply and fixing of steam dynamos and steam and exhaust pipes, £2,784, and (2) for the supply and fixing of a water softener; the Chloride Electrical Storage Syndicate, Ltd., for the supply and fixing of accumulators, £1,500, and £85 per annum for maintenance (if required); British Insulated Wire Company, Ltd., Prescot, for the supply and laying down of mains and underground work, £1,539 19s. 3d.; Chamberlain and Hookham, Birmingham, for supply of 60 meters, £304 10s.; James Carrick & Sons, Ltd., Edinburgh, for the supply and fixing of an overhead travelling crane, £196. The works will be erected on ground at the gas works.

Rathmines and Rathgar.—The Township Commissioners at their meeting last week, on the recommendation of the consulting engineer, Mr. Robert Hammond, decided to accept the following tenders for the plant for the township electricity works:—

SECTION A.—Boiler house plant—Three 30 × 8 feet Lancashire boilers and accessories, mechanical stokers, feed pumps, injector, economiser, electric motor, Messrs. R. Taylor & Sons, Marsdon ..	£2,924
SECTION B.—Engine house plant—One 300-kilowatt and one 150-kilowatt high speed steam dynamos, and accessories, motor transformer, spare parts, &c., Messrs. Mather & Platt, Limited, Manchester	£6,386
SECTION D.—10-ton overhead travelling crane, Messrs. Higginbottom and Mannock, Manchester	£264
SECTION E.—Switchboard and instruments, Mr. James White, Glasgow	£1,181
SECTION F.—Accumulators, The Tudor Accumulator Company, Limited	£1,958
SECTION G.—Underground work—trenching, cables, &c., British Insulated Wire Company, Limited, Prescot	£14,123
SECTION J.—Meters, Messrs. Ferranti & Co., Limited, Hollinwood	£500

FORTHCOMING EVENTS.

Friday, November 18th.—At 8 p.m. Institution of Civil Engineers, Students' meeting. Paper to be read, "Liquid Air: a short description of its Production, and summary of its Application to the Chemical or other Industries," by Cecil Lightfoot, Stud.Inst.C.E. Mr. W. H. Preece, C.B., F.R.S. (president), in the chair.

Monday, November 21st.—At 8 p.m. Society of Arts. "Acetylene," by Prof. Vivian B. Lewes. Cantor Lecture No. 1 on the history of acetylene; methods of formation; the chemistry of acetylene; the part played by acetylene in ordinary luminous flames.

Tuesday, November 22nd.—At 8 p.m. Institution of Civil Engineers. Paper to be further discussed, "Electrical Transmission of Power in Mining." By W. B. Esson, M.Inst.C.E.

Wednesday, November 23rd.—At 8 p.m. Society of Arts. Lecture on "Long Distance Transmission of Electric Power," by Prof. George Forbes, F.R.S.

Thursday, November 24th.—At 8 p.m. The Institution of Electrical Engineers. Adjourned discussion on "Rotatory Converters," by Prof. S. P. Thompson, F.R.S., vice-president.

Friday, November 25th.—At 5 p.m. Physical Society. Agenda: "On the Properties of Liquid Mixtures," by R. A. Lehfeldt. "On certain Diffraction Fringes as applied to Micrometric Observations," by L. N. G. Filon. Electro-Harmonic Concert. Ladies' night.

Wednesday, November 30th.—At 4 p.m. Royal Society. Anniversary meeting. At 7 p.m.: annual dinner at Hotel Metropole.

Wednesday, December 7th.—Institution of Electrical Engineers. Annual Dinner, Grand Hall, Hotel Cecil.

NOTES.

The Institution of Electrical Engineers.—The first meeting of the Institution of Electrical Engineers after the recess was held at the Institution of Civil Engineers on Thursday evening of last week, the 10th inst. Mr. J. W. Swan, president, in the chair. The President alluded to the loss sustained by the Institution by the deaths of Mr. Latimer Clark and Dr. John Hopkinson. Mr. Latimer Clark died at the ripe age of 76, after 40 years' work in electrical engineering, beginning with that branch in which the applications of electricity first took shape—telegraphy. Into the narrow space of 49 years Dr. John Hopkinson had crowded a vast amount of valuable and enduring work. His valuable contributions ranged over the period from 1881, while he was a member of council, 1882—85; vice-president, 1886—89; and president in the year 1890 and again in 1896. His most important papers were two on the propagation of magnetism in 1884 and 1885, and that submitted to the Royal Society in 1886 in conjunction with his brother, Dr. Edward Hopkinson, which embodied the complete theory of the dynamo. His name is identified with electrical distribution by the invention of the three-wire system, and it cannot be forgotten that to his patriotism the nation is indebted for the initiation of the corps of Electrical Engineer Volunteers. The President spoke feelingly of the sincere sorrow and great regret which the Council felt in having to record the loss of these two eminent members of the Institution, and felt it would be the wish of the members to unite in expressing such regret, a motion unanimously accepted by the meeting in silence. Prof. S. P. Thompson then read his paper on "Rotatory Converters," and afterwards showed a series of lantern slides illustrative of the apparatus described. The paper occupied so much time that the discussion was merely opened by Mr. Field in congratulatory terms, and was then adjourned until the 24th inst.

The Smoke Problem.—The London County Council is riding a high horse in regard to the Vestry of Lambeth and the smoke nuisance in that district. The Council has already, owing to the alleged default of the Vestry, taken proceedings against two firms, and is now seriously complaining of three other works. One of these is the generating station of the Electricity Supply Company in Commercial Road. Dr. Joseph Priestley, the Lambeth medical officer of health, has made a detailed inspection of the various works, which have been under observation for some months past. With regard to the electric light station, Dr. Priestley says:—"I find that there are at present nine boilers in use on the works, five of which were made by Messrs. John Brown & Co., and fitted with Ellis & Eaves' smoke prevention patent (induced draught), and the other four by Messrs. Hornsby, of Grantham (with open grids). I have had this factory under observation for some little time, and, as the result of verbal cautioning and notice, the firm have erected three extra (additional) boilers, made by Hornsby, of Grantham, and are in course of erecting a new (additional) shaft, the draught being previously insufficient, as also the boiler power. With this extra boiler plant and the additional new shaft (which will considerably increase the draught), there should be no further nuisance, and, considering these works are well in hand and will be completed in a few months, I am not in a position to advise the Committee to take further action before the magistrate for the present. Notices have been already served." The medical officer adds that it appears to him the Council limits itself to making observations by means of coal and police officers, without examining the premises and finding out the cause of such temporary smoke nuisances. He is satisfied that if a responsible officer of the Council would visit the premises along with the Lambeth "smoke" inspector or the medical officer, he would conclude that it would be unjust for any public body to harass the occupier under such conditions by taking further proceedings before the magistrate, at all events, for the present. Speaking generally, this expression of opinion is a clear explanation of the position of affairs in other districts. The County Council seems to take up a position which is not warranted by the circumstances of the case.

Motor Cars.—The third annual meet of the Motor Car Club took place on Monday morning in Whitehall Place. About 80 vehicles went as far as Sheen House, Richmond Park, where they were joined by about 20 others. The *Times*, commenting upon the trip, says:—"There was nothing of a very novel nature among the vehicles that took part in the run, the most striking being, perhaps, the jaunting car that headed the procession, and the big omnibus that followed in the rear. Builders do not appear to suffer from any excess of imagination, and their products are chiefly obvious adaptions of familiar horse-drawn types. At the same time it may be admitted that the motor car is gaining in general elegance, owing to increased attention to details of finish, and partly, perhaps, to the fact that people are becoming more accustomed to its appearance. As to the material used for propelling purposes, oil, with various forms of motor, was far and away the most common. Indeed, except for a number of the electric cabs that are now to be seen daily in the London streets, electricity and steam were practically unrepresented." A dinner was held at the Hotel Metropole in the evening.

The same night, at the Savoy Hotel, the Automobile Club of Great Britain and Ireland held a dinner to commemorate the second anniversary of the Locomotives on Highways Act. Mr. R. W. Wallace, Q.C., presided, and among those present were Lord Suffield, Mr. J. W. Swan, and Mr. Alexander Siemens.

The Engineering Trade.—A conference between the masters and men employed in the engineering trade took place on Thursday last week at the Hôtel Metropole. The representatives of the Employers' Federation, having held a preliminary meeting at the hotel, met in joint conference the representatives of the Amalgamated Society of Engineers, who had also held a preliminary meeting at the offices of the society in Stamford Street. At the end of the sitting, Mr. T. Biggart, secretary of the joint conference, stated (says the *Times*) that various questions had been brought by the conference under the provisions for avoiding disputes agreed upon in the recent terms of settlement. An application from Sheffield for a general advance of wages and for a reduction of working hours had been disposed of. A mutual recommendation had been agreed upon between the representatives of the masters and men assembled in London, which recommendation would be submitted to the parties concerned in Sheffield for their consideration in due course. An application from Dundee for a general increase of wages was also considered, and a recommendation, which will be submitted to the men, was agreed to on both sides. The exact terms of the general recommendation will not be made public until they have been considered by those locally interested.

The Bradford Tramway Accident.—Major Cardew's report to the Board of Trade after his inquiry into the Bradford electric tramcar accident has been received in Bradford. In it he states, according to yesterday's *Times*, that in his opinion the accident was due to the car not being run within the limit of speed—namely, six miles an hour—and the unfortunate combination of a driver with very little experience and a conductor with none at all, but with a little knowledge, which is proverbially a dangerous thing, a slippery road, and extra pressure on traffic due to Barnum's Show. The driver used the brake-power in an injudicious manner, but the conductor put on the hand-brake and thus deprived the driver of full control of the brake-power. He also caused the trolley to be disconnected, thus depriving the driver of the power of reversing, which might have prevented the accident. Major Cardew considers that the brake-power was ample, and that by means of the graduation of the electric brake the speed can be regulated with ease and certainty provided that six miles an hour is not exceeded. He approves the addition of a slipper brake. The Bradford Corporation Tramways Company considered the report on Wednesday, and decided to accept liability, and agreed to see that a speed of six miles an hour was observed.

Motor Cars.—Prof. H. Hele Shaw, LL.D., has been lecturing at Liverpool on "The Modern Motor Vehicle and its Future."

What Happened to Kershaw!—So the cat is out of the bag at last! "What earthly reason was there," said Mr. Howlett, at a meeting of the Shoreditch Vestry, the details of which our readers will peruse with mixed feelings, "for indicating an inflated profit *to show up the electrical papers?*" Our contemporaries, equally with ourselves, will have learnt with heartfelt regret that poor Mr. Kershaw, after keeping up such a defiant attitude on the profitable nature of the Shoreditch dust destructor for some 12 months, should now be compelled to eat humble-pie in large mouthfuls, and instead of showing up the electrical papers, he has only succeeded in making a rare exhibition of himself. Such a complete climb down we have seldom seen, and we can but feel some slight gratification that our frequent criticisms of this destructor scheme should have been so absolutely justified by the result. Mr. Kershaw is doubtless a sadder, if not a wiser man, and it is to be hoped that the object lesson afforded by Shoreditch will not be lost sight of by vestrymen generally who would pose as authorities on matters which only an engineer can possibly understand. It is rather late in the day to say that his remarks at the opening of the Shoreditch station were based upon information supplied by the contractors, and such an excuse comes with a bad grace from a gentleman of Mr. Kershaw's boundless assurance. Perhaps the most remarkable utterance of all at this extraordinary meeting was the statement of the accountant that he had not audited the accounts, which had been sent to him to be looked over, with instructions not to make any alterations. However, we shall probably deal with the subject further in our next issue, by which time Mr. Kershaw will possibly have become a convert to the views expressed by the electrical papers. But the alpha and omega of Mr. Kershaw can only be properly appreciated and thoroughly relished by a perusal of the articles and correspondence on the refuse of Shoreditch which have appeared in our columns since the date of the opening ceremony.

Lectures.—Mr. Thomas Rouet, of Newton Stewart, yesterday delivered at Wigtown a lecture on "Light," tracing the developments from "mutton fat cruizie" to electricity and acetylene gas. This is the first of a course of a dozen lectures which Mr. Rouet will deliver in various Scotch towns and districts within the next week or so.

Mr. A. H. Gibbings, last Friday, delivered a lecture before the Bradford Scientific Society on "The Application of the Electric Motor to Small Industrial Purposes, and its Effects on Trade and on the Community Generally."

Dr. Fleming, on 8th inst., delivered a lecture in the Blackburn Town Hall on "Electricity."

On Monday last a lecture was delivered in St. Catherine's Schoolhouse, Dublin, by Prof. Barrett, on "Electric Trams."

On 10th inst. Prof. A. Jamieson delivered the last lecture of his series on "Electric Railways and Tramways," at the Glasgow Technical College.

Memorial to Dr. Hopkinson. — Alderman John Hopkinson, the members of his family and near relatives, have offered to the Owens College, in memory of the late Dr. John Hopkinson, a gift of £1,600 to cover the expense of building the dynamo house connected with the new Physical Laboratory. It is hoped that by additional contributions from friends, who desire to see a suitable memorial to Dr. John Hopkinson in Owens College, where he was a student for three years, it may be possible to complete and equip the annexe containing, in addition to the dynamo house, a number of rooms devoted to electro-technics, and that the whole may be known as the "Dr. John Hopkinson Electro-technical Laboratory."

The Importation of Foreign Dynamos.—It may surprise American electrical engineers, says the *Electrical World*, who have been congratulating themselves of late on the use of American electrical machinery in foreign lands, to find that three large direct-coupled alternators have been built by Messrs. Brown, Boveri & Co., Baden, Switzerland, for an American gold mining company. The machines are of the fly-wheel field magnet type, mounted on the shafts of three cross-compound horizontal Allis-Corliss engines.

An Interesting Function.—On Friday evening last a large and distinguished party assembled at the Hôtel Métropole, when a dinner was given by the Chemical Society to the following past presidents, who have been Fellows for half a century:—Sir Joseph Henry Gilbert, Sir Edward Frankland, Prof. William Odling, Sir Fredk. Augustus Abel, Dr. Alex. William Williamson, and Dr. John Hall Gladstone. The chair was taken by the president of the Society, Prof. Dewar, who, in proposing the toast of the past presidents, said the labours of these men had added enormously to the resources of mankind. As experimentalists their equals were not likely to be seen again, and they had rendered the science of chemistry more glorious than it ever had been.

Boiler Fatality at Messrs. Siemens's Works.—On Saturday last a serious boiler accident occurred at the works of Messrs. Siemens Bros., Woolwich. Three men were engaged cleaning out a boiler, which was connected with two others, when the exhaust of one of them was let into the boiler that was being cleaned. The result was that two men were killed, and a third received slight injuries. An inquest on the bodies of the two men was held at Greenwich on Wednesday. Evidence having been given by the manager and others, the jury returned a verdict of "Accidental death," and added a rider that boilers whilst being cleaned out should be disconnected.

Theta-Phi Chart.—We have received from Messrs. Albert Frost & Sons, of Rugby, a copy of Captain Sankey's Theta-Phi Chart, which embodies in graphic form the properties of steam from 100° to 400° F. for the purpose of the thermo-dynamic investigation of steam engine performance. These charts are sold at 3s. each. They are clearly printed, and may also be had mounted, and at a reduction for quantity.

Appointments Vacant.—The Newington Vestry want a resident electrical engineer to take charge, under the consulting engineers, of the erection, &c., of machinery at the new electricity works, and to afterwards run the plant. Salary £250. See our "Official Notices" this week for particulars.

A technical instructor is wanted by the Indian Government for the Thomason Engineering College, Roorkee. See our "Official Notices."

Stretford Electric Lighting.—On Tuesday the Council resolved to appoint Mr. R. P. Wilson, of Westminster, at a stated fee, to advise as to the various schemes relating to the supply of electricity.

Bedford Telephones.—The Town Council on Wednesday resolved to apply for a telephone license.

Obituary.—The death is announced, at the age of 60 years, of Mr. Thomas Moore, of Northwich, a director of the Northwich Electric Light Company.

The Heilmann Locomotive.—The *Revue Internationale de l'Electricité* comments very favourably upon the last Heilmann engine now running on the Paris-Havre line. Particular note is made of the easy running and freedom from vibration, which is very creditable to a colossus of 120 tons weight. We look forward with interest to further reports.

Electric Motors in Shipyards.—It is stated that a full equipment of electric motors is being put down at the yards of Sir James Laing & Sons, at Sunderland, for driving the machinery.

Manchester Trams.—The City Council on Wednesday decided, after considering an exhaustive report by a special committee, to adopt the overhead wire system for working the municipal trams. The Council also accepted a recommendation to abolish all meter charges, which means a loss on revenue account of £2,000 per annum.

CITY NOTES.

The Cuba Submarine Telegraph Company, Limited.

The directors' report for the half-year ending June 30th, 1898, to be presented at the meeting to be held on November 23rd, at Winchester House, E.C., says:—

The directors beg to submit, duly audited, the balance-sheet and accounts for the half-year ended June 30th last. From these it will be seen that the total receipts amount to £33 504 2s. 8d., and the gross expenditure to £8,091 11s. 3d., leaving a sum of £25,412 11s. 5d., which, added to the balance of £3,254 8s. 11d. brought from the last account, leaves £28,667 0s. 4d. at the credit of revenue account. The traffic receipts show an increase of £7,916 13s. 1d. as compared with the corresponding period of last year, which abnormal amount is mainly due to the continuance of the insurrection, followed by the Spanish-American war. The sum of £15,553 8s. 10d. has been added to the reserve fund, which, after deducting £7,550 15s., the balance of cost of the Manzanillo-Santiago cable, and £4,002 13s. 10d. for cable repairs, now stands at £110,000. The dividend on the preference shares will absorb £3,000, and leave £10,113 11s. 6d., out of which the directors recommend the payment of a dividend at the rate of 6 per cent. per annum and a bonus of 2s. per share on the ordinary shares, both free of income-tax, the balance, £3,713 11s. 6d., being carried forward to the current half-year. The cable between Manzanillo and Santiago was successfully completed in February last, and the broken Cienfuegos-Santiago section joined up at Cape Cruz, thus restoring the communication between Cienfuegos and Santiago by the 1881 cable. The directors regret that, owing to the operations of the war, considerable damage was done to the company's property, but the board are pleased to report that since the termination of hostilities the broken cables have been repaired, with the exception of the Cienfuegos-Casilda section, and the 1891 cable between Cienfuegos and Batabano, which will be put in order as soon as possible. Notwithstanding these interruptions, the directors are glad to state that the through communication has been continuously maintained, the staff remaining at their posts under very trying circumstances. The retiring director is Mr. Alexander G. Low, who, being eligible, offers himself for re-election. Mr. John Gane, the auditor, also retires, and offers himself for re-election.

The Western and Brazilian Telegraph Company.

The thirty-sixth ordinary general meeting of the shareholders of this company was held on Friday last at Winchester House, Mr. W. S. Andrews presiding.

The Chairman, in proposing the adoption of the report, said that at the corresponding period last year he was obliged to lay on a little black paint. It was indeed the very worst period that they had had to suffer under, and things were not at all wearing an appearance of cheerfulness, but although the accounts came out badly he was enabled to feast the shareholders a little bit upon prospects. He told them that the revenue was continuing to increase and the expenses were continuing to diminish, and, therefore, they went away in a comparatively cheerful state of mind. He was pleased to say that their forecasts in both cases had turned out to be correct and the accounts now before them showed great improvement over the corresponding half-year. The earnings had exhibited a considerable improvement, having reached £72,692 as compared with £59,754, an increase of no less than £12,937, and in addition to that they were fortunate to have received some £10,000 from the Platino Company in the half-year against £11,000 for the whole of 1897. The expenses showed a satisfactory diminution, they having amounted to £39,376 against £44,575, a decrease of £5,199. The decrease was mainly in shipping, and in spite of the higher price of coal and the ship being more at sea; the great point being that at the corresponding period they had ships on hire, whereas this half-year their own ship had done the whole of the work. After deducting the expenses they brought forward a balance of £33,316, and, adding the amount brought forward—£1,428 and the £10,169 received as dividends from the Platino Company, they had a total of £44,914. From that balance they had to deduct debenture interest, £8,014; debenture redemption fund, £1,078; amount added to reserve fund, £8,000; income-tax, £2,016; altogether £19,136, which left £25,777 and enabled them to recommend a dividend of 5s. per share and to carry forward a balance of £1,427 for the benefit of the coming half-year. When they remembered that at the corresponding half-year they had to withdraw £7,500 from the reserve fund in order to enable them to declare a dividend of 3s. per share, whilst this half they had 5s. per share, and added £8,000 to the reserve, he thought they would agree that it was not a bad outcome, and that it fully justified the sanguine anticipations that he indulged in. They were aware that the requisite number of Western and Brazilian shares having been sent in for exchange for Brazilian Submarine shares, the agreement between the companies had become operative. As they knew that agreement was not for an amalgamation, but was confined to what promised to be a very successful effort to unify their interests. The independent organisation and working of the companies under their concessions and their obligations remained identically the same, and in order to secure the objects that they had in view, viz., the harmonious working of the undertakings for a common end, recourse had been had to similar measures to those adopted in the case of the Platino Company. He supposed on account of his seniority he had been appointed chairman of the Western Company, and in carrying out the arrangements they had endeavoured to make as little alteration as they possibly could, while identifying as closely as possible the three companies. It was rather early days, of course, but still they had had some actual experience of the results that it was anticipated would accrue from the homogeneity of management and working, and that experience encouraged them in the opinion that they had made no mistake, and the companies working together would be able to secure the public advantages as regarded service, while at the same time it would be advantageous to the shareholders.

Lord R. H. Brownr seconded the motion.

Some discussion ensued on the suggestion of a shareholder, that the preference dividend should have been increased, and a smaller amount added to the reserve fund, but eventually the report was adopted unanimously.

Potteries Electric Traction Company, Limited.

This is a subsidiary company of the British Electric Traction Co., and has been formed with a share capital of £400,000, divided into 20,000 5 per cent. preference of £10 each and 20,000 ordinary shares of £10 each. It is proposed to undertake a large scheme of electric tramways in the Potteries district, some 33 miles in extent, which embraces the control of tramways owned by the North Staffordshire Tramways Co. and tramways in the borough of Longton. The former system is being converted for electrical working. The debentures, shares, consols, rights, and interests are being transferred by the parent company for £152 410, payable by 6,666 ordinary shares and the remainder in cash. The purchase price includes £91,392, being actual payments to September 15th, 1898, so we may fairly assume the balance of £61,018 represents profit to the vendor company. It is estimated that the net profits, without depreciation, will be £40,000, but if the company exercises its right to call up its £200,000 of debentures, which in two years will probably be necessary, we are afraid debenture interest and depreciation may leave a limited amount to be divided among ordinary shareholders.

The Yorkshire House-to-House Electricity Company, Limited.—An extraordinary general meeting of the members of the Yorkshire House-to-House Electricity Company, Limited, will be held at the registered office of the company, 1, Whitehall Road, Leeds, on Monday, November 21st, 1898, at 2.30 p.m., when the directors will submit for the consideration of the members an agreement which had been provisionally arrived at between the board and the Corporation of Leeds, with the object of settling the terms on which the Corporation are to be entitled to put in force the power conferred upon them by the "Leeds Electric Supply Order, 1891," of becoming the purchasers of the company's undertaking. The agreement may be seen on application to the company's solicitors, Messrs. Nelson, Barr & Nelson, 4, South Parade, Leeds.

Stock Exchange Notices.—Applications have been made to the Stock Exchange Committee to appoint a special settling day in and to grant a quotation to the Great Northern and City Railway Company—4 per cent. preferred ordinary or class "A" shares of £10 each, and 5 per cent. deferred ordinary or class "B" shares of £10 each.

The Edison & Swan United Electric Light Company, Limited.—This company has this week made an issue of £150,000 4 per cent. debenture stock, being the balance of a total amount of £350,000 authorised by resolution of the shareholders dated November 24th, 1896. The London Trust Company, Limited, was authorised to offer the stock for subscription at 99.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending November 12th, 1898, were £229 17s. 9d.; aggregate to date, £13,365 10s. 3d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending November 11th, 1898, were £2,159 18s. 8d.; corresponding period, 1897, £2,498 2s. 11d.; increase, £109 13s. 1d.

The City and South London Railway Company.—The receipts for the week ending November 13th, 1898, were £1,056; week ending November 14th, 1897, £1,081; decrease, £25; total receipts for half-year, 1898, £19,360; corresponding period, 1897, £18,661; increase, £699. Miles open, 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending November 12th, 1898, were £161 18s. 4d.; week ending November 13th, 1897, £98 8s.; increase, £63 10s. 4d.; total receipts to date, 1898, £7,502 8s. 10d. Miles of track open week ending November 12th, 1898, 3; week ending November 13th, 1897, 2. Car miles run week ending November 12th, 1898, 4,306; week ending November 13th, 1897, 1,902. Number of cars week ending November 12th, 1898, 11; week ending November 13th, 1897, 5.

The Dublin United Tramways Company.—The receipts for the week ending November 11th, 1898, were as follows:—D. U. T. Co., horse cars, £2,289 11s. 2d.; ditto, electric cars, £353 0s. 8d.; D. S. D. Co., electric cars, £788 17s.; total, £3,431 8s. 10d; corresponding week last year—D. U. T. Co., horse cars, £2 685 13s. 11d.; ditto, electric cars, £37 4s. 8d.; D. S. D. Co., electric cars, £411 15s.; total, £3,084 13s. 7d.; increase, £346 15s. 3d.; aggregate to date, £79,332 9s. 1d.; aggregate to date last year, £73,187 10s. 11d.; increase to date, £6,144 18s. 2d. Worked:—The mileage open is 13 miles electrically, 31 miles by horses, as against 8 miles electrically, and 34 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways Company.—The receipts for the week ending November 9th, 1898, were £233; total receipts to date, 1898, from June 29th, £5,174. Miles of track open, 3½. Car miles run, 3,533. Number of cars, 10.

The Liverpool Overhead Railway Company.—The receipts for the week ending November 13th, 1898, amounted to £1,436; corresponding week last year, £1,283; increase, £153.

The South Staffordshire Tramways Company.—The receipts for the week ending November 11th, 1898, were £660 15s. 5d.; week ending November 12th, 1897, £597 19s. 3d.; aggregate receipts for 45 weeks, £28,547 11s. 11d.; last year, £28,729 10s. 11d.

The Western and Brazilian Telegraph Company, Limited.—The receipts for the week ending November 11th, 1898, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,124.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation, Nov. 9th.	Closing Quotation, Nov. 16th.	Business done during week ended Nov. 16th, 1898. Highest.	Lowest
127,400£	African Direct Telegraph, 4 % Debs.	100	4 %	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	5 — 6	3½— 4½	...	...
125,000	Do. do. 5 % Debs. Red.	100	...	...	...	92 — 95	92 — 95	...	...
905,560£	Anglo-American Telegraph	Stock	£2 9s	£2 13s	3 %	61 — 64	63 — 66	64	62
3,047,220£	Do. do. 6 % Pref.	Stock	£4 18s	£5 6s	6 %	112½—113½	114 —115	115	114
3,047,220£	Do. do. Deferred...	Stock	...	...	...	14¾— 14⅞	15⅛— 15⅜	15⅞	14⅞
130,000	Brazilian Submarine Telegraph	10	7 %	7 %	7 %	15¼— 15⅜	15⅛— 15⅜	15⅜	15⅛
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	5 %	...	...	111 —115	111 —115	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	4 %	2⅜— 3½	2⅜— 3½	...	...
10,000,000$	Commercial Cable	$100	7 %	8 %	8 %	180 —190	180 —190	...	...
918,297£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	...	...
224,850	Consolidated Telephone Construction and Manufacturing	10/-	1½%	2 %	...	1/16— 1/16	1/16— 1/16	...	...
16,000	Cuba Telegraph	10	8 %	8 %	7 %	8½— 9½	10 — 11	10⅜	10
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	16 — 17	16½— 17½	17½	16⅛
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 11	10 — 11	...	...
30,000£	Do. do. 4½ % Debs., Nos. 1 to 6,000 ...	50	4½%	4½%	4½%	104 —107%	104 —107%	...	...
60,710£	Direct United States Cable	20	2½%	2½%	...	11½— 12	11½— 12	12	11⅞
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	101—104	101 —104	103	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	...	...	...	172 —177	172 —177	176	172
1,295,000	Do. 3½% Pref. Stock	100	...	...	...	104 —107	104 —107	106	104¾
500,000	Do. Prov. Certs., 50 % paid	...	...	...	...	52 — 55	53 — 56	...	...
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	5 %	100 —103	101 —104	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	124 —128	124 —128	127	125½
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	17½— 17¾	17½— 17¾	17¾	17 7/16
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	5 %	100 —104	100 —104	102	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	5 %	101 —104	101 —104	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	125 —129	125 —129	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	...	100 —104	100 —104	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	...	101 —104	101 —104	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	4 %	...	102 —105	102 —105	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	4 %	...	102 —105%	102 —105%	...	...
180,227	Globe Telegraph and Trust	10	4½%	4½%	4½%	12 — 12½	12 — 12½	12⅝	12½
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	16½ — 17	16½ — 17	16⅝	16⅜
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	10 %	28½— 29½	28½— 29½	...	...
150,000£	Do. do. do. do. 5 % Debs. ...	100	5 %	5 %	5 %	100 —103	100 —103	...	...
97,800	Halifax & Bermuda Cable, 4½% 1st. Mt. Dbs., w'n. 1-1,200, rd.	100	...	...	...	101 —104	101 —104	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	53 — 56	54 —57	56	55
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	6 %	109 —112	109 —112	...	...
484,597	National Telephone, 1 to 484,597	5	5⅛%	5⅛%	6 %	5¼— 5½	5¼— 5½	5⅝	5 5/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	13	12⅞
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	13½	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅛— 5⅝	5⅛— 5⅝	5 5/16	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	100—103	100 —105	102½	101½
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅝— ¾	⅝— ¾	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	4 %	105 —108	105 —108	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	133 —138	133 —138	136	...
58,000	United River Plate Telephone	5	4 %	5 %	6 %	4¼— 4⅜	4¼— 4⅜	...	...
151,733£	Do. do. 5 % Debs.	Stock	5 %	...	...	103 —106	103 —106	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	5 %	99 —102	99 —102	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼— ⅜	¼— ⅜	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	104 —107	104 —107	...	...
64,269	Western and Brazilian Telegraph	15	3 %	2 %	3½%	12¼— 12⅜	12¼— 12⅜	12⅝	12⅜
33,129	Do. do. do. 5 % Pref. Ord.	7½	5 %	5 %	5 %	8 — 8½	8 — 8½	...	...
33,129	Do. do. do. Def. Ord.	7½	1 %	nil	½%	4 — 4½	4 — 4½	4 3/16	...
389,521	Do. do. do. 4 % Deb. Stock Red. ...	Stock	...	...	...	107 —110	107 —110	108½	107
88,321	West India and Panama Telegraph	10	⅞%	1 %	⅞%	1⅛— 1⅜	1⅛— 1⅜	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	6 %	9½— 9¾	9½— 10	...	...
14,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	6 %	7 — 9	7 — 9	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	106 —109	106 —109	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	6 %	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	5 %	6 %	7 %	11 — 12	11½— 12½	12	...
20,000	Do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	5 %	6 %	8 — 9	8 — 9	8½	8⅜
60,000	Do. do. do. 4½ % Deb. Stock Red....	Stock	4½%	4½%	4½%	113 —115	113 —115	...	...
50,000	City of London Electric Lighting, Ord. 40,001—90,000 ...	10	5 %	7 %	10 %	23½— 24½	24 — 25	24 9/16	24
10,000	Do. Ord. Nos. 90,001 to 100,000	10	...	...	...	23 — 24	23½— 24½	...	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	15½— 16½	15½— 16½	15¾	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	127 — 132	127 —132	...	...
30,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—30,000	10	nil	nil	nil	12½— 13½	12½— 13½	...	...
10,000	Do. do. do. Nos. 30,001 to 40,000 £8 paid.	10	...	...	...	10 — 11	10 — 11	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	14½— 15½	14½— 15½	15¼	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	...	5 %	5 — 5½	5 — 5½	...	...
15,661	House-to-House Electric Light Supply, Ord., 101 to 15,761	5	...	...	4 %	9 — 10	9 — 10	9½	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	7 %	9½— 10½	9½— 10½	9 15/16	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	...	6¼— 6⅝	6¼— 6⅝	...	...
62,400	*Metropolitan Electric Supply, 101 to 62,500	10	4 %	5 %	6 %	15½— 16½	16 — 17	17	16½
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	4½%	117 —121	117 —121	...	...
6,452	Notting Hill Electric Lighting	10	2 %	4 %	6 %	15 — 16	15 — 16	15½	15⅛
31,980	*St. James's and Pall Mall Electric Light, Ord.	5	7½%	10½%	14½%	16 — 17	16½— 17½	17⅜	17
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	9¼	9
50,000	Do. do. 4 % Deb. Stock Red. ...	Stock	...	...	4 %	105 —108	105 —108	...	...
65,000	South London Electricity Supply, Ord., £3 paid ...	5	...	...	...	2⅞— 3⅛	2⅞— 3⅛	2 15/16	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	7 %	9 %	12 %	15 — 16	16 — 17	16½	15 13/16

* Subject to Founder's Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation Nov. 9th.	Closing Quotation Nov. 16th.	Business done during week ended Nov. 16th, 1898. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	...	...	...	2⅞— 3⅛	2⅞— 3⅛	3⅛	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	94 —100	94 —100	...	...
30,000	British Electric Traction	10	...	...	...	16½— 17½	16½— 17½	17½	17
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	13 — 14	13 — 14	13⅛	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	2½%	*nil*	*nil*	1⅝— 1⅞	1¾— 2	1⅞	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	*nil*	4 %	2 — 2¼	2⅛— 2⅜	2¼	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	109 —113	109 —113	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	102 —105	102 —105	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	...	...	...	9½— 10½	9½— 10½	9⅝	...
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	110 —113	110 —113	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10 — 10⅛	10 — 10½	10½	10 3/16
178,303	Do. do. do. £6 paid	10	...	...	...	5⅞— 6⅛	5⅞— 6⅛	6⅛	...
61,033	Do. do. Pref. half-shares £1 paid ...	...	...	...	...	1¼— 1⅜	1¼— 1⅜	1⅜	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	4½— 5	4½— 5	4½	...
630,000*l*	City and South London Railway	Stock	1⅛ %	1 1/16 %	1⅛ %	69 — 71	69 — 71	69½	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £4 pd.	10	...	...	...	3½— 4	3½— 4	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	1½— 2	1½— 2	...	...
82,850	Do. 5% 1st Mort. Reg. Debs., 1 to 743 of £100, and 901 to 1,070 of £50 Red.	...	...	...	...	91 — 96	91 — 96	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5 %	5½%	6 %	2¼— 2⅜	2 — 2½	2 7/16	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5 %	5½%	6 %	4 — 5	4 — 5	...	...
194,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	100 —102	99 —101	...	...
110,000	Electric Construction, 1 to 110,000	2	5 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	2 5/16	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	2⅜— 3¼	2⅜— 3¼	3⅛	3
111,100	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	105 —107	105 —107	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	¼— ½	¼— ½	...	...
67,275	Elmore's Wire Manufacturing, 1 to 69,385, issued at 1 pm.	2	...	...	...	¼— ½	¼— ½	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	10½%	7 %	7 %	10 — 12	10 — 12	...	...
12,500	Henley's (W. T.) Telegraph Works, Ord.	10	8 %	10 %	12 %	20½— 21½	20 — 21	20⅞	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18 — 19	18 — 19	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	4½ %	110 —115	110 —115	113¾	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	22 — 23	22 — 23	22 1/16	22½
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	105½	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅝%	2⅝%	3½%	10 7/16 — 10 9/16	10 7/16 — 10 9/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	15½— 16	15½— 16	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	39	38
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	104 —107	104 —107	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	...	106 —111	107 —112	111½	110½

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10⅛.
British Aluminium, Ordinary, 10—12; 7 % Pref., 11—13.
House-to-House, 4½% Debentures of £100, 105—108.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 13—14; 1st Preference Cumulative 6%, £5 (fully paid), 7¾—8¼. Debentures, 105—108. Dividend, 1897, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, 5/16—7/16.
Smithfield Market Electric, 3—4.
*T. Parker, £10 (fully paid), 14.
Yorkshire House-to-House Electricity, £5 Ordinary Shares fully paid, 7¾—8¼. Dividend for 1896—6%.

* From Birmingham Share List.

Bank rate of discount 4 per cent. (October 13th, 1898).

MARKET QUOTATIONS, Wednesday, November 16th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	22/-	22/-	..
a „ Oxalic .. .. .. per cwt.	33/-	33/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per ton	37/-	37/-	..
a Ammonia, Muriate (grey) .. per ton	£19	£19	..
a „ „ (white) .. per ton	£26	£26	..
a Bleaching powder .. .. per ton	£6 15	£6 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. per ton	£14 10s.	£14 10s.	..
a Benzole (90 %) .. .. per gal.	7/-	7/-	..
a „ (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£18 10s.	£18 10s.	..
a Lead, Nitrate .. .. .. per ton	£23 10s.	£23 10s.	..
a „ White Sugar .. .. per ton	£30 10s.	£30 10s.	..
a „ Peroxide .. .. .. per ton	£27 10s.	£27 10s.	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3¾d.	3¾d.	..
a „ Caustic (75/80 %) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	65/-	65/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6 10	£6 10	..
a „ Recovered .. .. per ton	£5 10	£5 10	..
a „ Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£8 15	£8 15	..
a „ Crystals .. .. .. per ton	£8	£8	..
a „ Bichromate, casks .. per lb.	3d.	3d.	..

METALS, &c.	This week.	Last week.	Increase or Decrease.
b Aluminium Wire, in ton lots .. per ton	£224	£224	..
b „ Sheet, in ton lots.. per ton	£191	£191	..
c Brass (rolled metal 2" to 12") basis per lb.	6¾d.	6¾d.	..
c „ Tube (brazed) .. .. per lb.	8¾d.	8¾d.	..
c „ Wire, basis .. .. per lb.	7d.	7d.	..
f Ebonite Rod .. .. .. per lb.	3/-	3/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£67	£65	£2 inc.
g „ Wire (basis price) .. per lb.	8d.	8d.	..
g „ Sheet .. .. .. per ton	£67	£65	£2 inc.
g „ Rod .. .. .. per ton	£67	£65	£2 inc.
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	5/6	5/6	..
h India-rubber, Para fine .. per lb.	3/10½ forw'd	4/- forw'd	1½d. dec.
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) per ton	50/4½	48/11½	1/5 inc.
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. per ton	45/-	45/-	..
i „ Wire galvanised No. 8 .. per ton	£8 15	£8 15	..
g Lead, English Ingot .. .. per ton	£13 12 6	£13 10	2/6 inc.
g „ „ Sheet .. .. per ton	£14 12 6	£14 7 6	5/- inc.
l Mica (uncut slabs 8" long) .. per lb.	6/6	5/6	1/- inc.
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£7 9	£7 9	..
o Platinum .. .. per oz.	£3 17 6	£3 16	1/6 inc.
i Steel, Magnet, according to description .. .. .. per ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£85 10	£86 to £87	dec.
g „ foil .. .. per lb.	1/3	1/4	1d. dec.
n „ wire Nos. 1 to 16 .. .. per lb.	1/4	1/4	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	6¾d.	6¾d.	..
„ Flax, 6 or 8 lea... .. per lb.	3¾d.	3¾d.	..
j „ Hemp, 3 ply 10 lbs. .. per lb.	3¾d.	3¾d.	..
j „ „ Russian, 10 lbs. per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove .. per ton	£12	£12	..
j „ Manila, 24 thread .. per ton	£30	£30	..
k Zinc, Sheet (Vielle Montagne bnd.) p. t.	£29 10	£29 10	..

a Quotations supplied by Messrs. G. Boor & Co.
b „ „ „ The British Aluminium Co., Ltd
c „ „ „ Messrs. Thos. Bolton & Sons.
d „ „ „
e „ „ „
f „ „ „ The India-Rubber, G.-P., and Teleg. Works Co Ltd
g „ „ „ Messrs. James & Shakspeare.
h „ „ „ „ Jackson & Till.
i Quotations supplied by Messrs. Bolling & Lowe.
j „ „ „ „ Henry C. Yeo & Co.
k „ „ „ „ Morris Ashby, Limited.
l „ „ „ „ Sanders, Wake & Co.
m „ „ „ „ W. T. Glover & Co., Ltd.
n „ „ „ P. Ormiston & Sons.
o „ „ Johnson Matthey & Co., Ltd.

INSTITUTION OF ELECTRICAL ENGINEERS.

"ROTATORY CONVERTERS." By Prof. SILVANUS P. THOMPSON, D.Sc., F.R.S., Vice-President. (Paper read November 10th, 1898.)

So much interest is concentrated at the present time upon the transmission and distribution of electric energy for motive and locomotive power, as well as for lighting, that attention may profitably be directed to a class of machines which hitherto have been little discussed, namely, rotary converters.

In general, a rotatory converter may be described as a machine having something in common both with a dynamo and with a motor, so far as its structure goes, and of which the function performed by its rotation is to transform the electric energy which is imparted to it in one form into an output of electric energy of some other form. Of such converters there are many varieties, subserving many different uses. For example, one sort of rotatory converter will change continuous currents at one voltage into continuous currents at a different voltage. Another will change two-phase alternating current into three-phase alternating current. Another will change three-phase alternating current into continuous current. Yet another will change an alternating current of a certain frequency into an alternating current of a different frequency.

In the following table of the principal conversions which may thus be accomplished, C stands for continuous current, A_1 for alternate current of single-phase, A_2 for two-phase, A_3 for three-phase,

1.—C to C at higher or lower voltage.
2.—A_1 to A_1 " "
3.—A_2 to A_2 " "
4.—A_3 to A_3 " "
5.—C to A_1, or A_1 to C.
6.—C to A_2, or A_2 to C.
7.—C to A_3, or A_3 to C.
8.—A_1 to A_2, or A_2 to A_1.
9.—A_1 to A_3, or A_3 to A_1.
10.—A_2 to A_3, or A_3 to A_2.
11.—A_1 to A_1 of different phase.
12.—A_1 to A_1 of different frequency.

Any one of these conversions might be accomplished by selecting an appropriate motor to receive and be driven by the primary current, and coupling it to a generator to give out a secondary current of the species desired. It will be noted that of these conversions, No. 2 is the ordinary alternate current transformation, and is better accomplished by ordinary stationary transformers, as also are Nos. 3 and 4. By a suitable combination of stationary transformers, No. 10 can also be effected, whilst Nos. 8 and 9 may be more or less satisfactorily effected by the use of auxiliary choking coils and condensers. But all of them may, and all the others must, be effected by means of rotatory apparatus. From the above list there have been omitted several possible cases of conversion, as, for example, that of a current supplied at fixed voltage, but of varying amperage, to a current of fixed amperage, but delivered at varying voltage.

It is not proposed here to deal, save purely incidentally, with the continuous current transformer (No. 1 of the above table), which was brought before this Institution seven years ago by Major-General Webber (Vol. xx., p. 63, 1891), nor with phase transformers (Nos. 8, 9, 10, and 11), nor with frequency transformers (No. 12), nor with any stationary kind of transformer. This paper will be directed to the machines devoted to the purpose of converting continuous currents into alternating currents of one, two, or three phases, or *vice versâ*. The importance which such machines have now assumed in the electrical industry arises from several causes. Long distance transmission, with its corollary of the employment of high voltages, has demanded for this service alternating currents. The development of the electric tramway with continuous current motors has called for methods of feeding at distant points. For this service rotatory converters are required. Also for charging accumulators in cases where the public supply is an alternating one, and for factory driving with three-phase motors in cases where the public supply is one with continuous currents, rotatory converters are wanted. All these cases might, of course, be met by the use of coupled machines, motor and generator. An early example of this method was afforded by the lighting station at Cassel, where the high voltage alternating transmission was effected by the use of synchronous single-phase alternators and the town distribution by continuous current dynamos coupled to the shaft of the synchronous motors. Even now, in the case of a three-phase transmission and a continuous current distribution, some engineers recommend the use of a group converter consisting of a non-synchronous three-phase motor coupled to a continuous current dynamo. But in all such cases the efficiency of the group is necessarily lower than that of either of its component parts. If a motor having, say, a 90 per cent. efficiency is coupled to a dynamo, also of 90 per cent. efficiency, the efficiency of the group cannot possibly exceed 81 per cent.

Two other solutions to the general problem are possible. One is to wind the revolving armature with two sets of windings—one to receive the primary current and revolve as a motor, the other to generate the secondary current. As only one field magnet and one pair of bearings are required, there is an obvious economy of material, though no great saving in efficiency. Another solution—not, it is true, of universal application, but having the advantage of effecting a considerable increase of efficiency as well as an economy in material—is to wind the armature with but one set of windings, furnished at one end with a commutator, and at the other with appropriate contact rings, the same winding serving both to receive the in-coming primary current and to generate the secondary current. It is this specialised type of machine which is the main subject of the present discussion, and which is called *par excellence* a rotatory converter.

At this point it may be convenient to drop the adjective "rotatory," and speak simply of *converters*, leaving the term "transformer" to denote the stationary apparatus.

Converters of a simple kind have been known for many years. Ever since 1885 there has been one at the Technical College, Finsbury, consisting of a bipolar Gramme machine with the ordinary commutator, with the addition of two insulated contact rings at the other end of the armature, these rings being connected to two points on the winding at opposite ends of a diameter. It therefore belongs to the species C A_1 (or No. 5 of Table I.). The addition of three contact rings connected to three symmetrical points on the winding would constitute a machine of the species C A_3 (or No. 7 of Table I.)

It may be convenient here to point out the relation between the number of contact rings (called for brevity slip rings) that are applied in any alternate current generator, and the uses to which such generator may be put with respect to the phasal relations of the currents that may be drawn from it. For brevity these are enumerated in the following table. The figures in the second column relate to the angles between the points on the winding at which the slip rings are connected for the simple case of a bipolar machine.

TABLE II.

No. of slip rings.	Angle.	Possible service.
2	180°	Single-phase.
3	120°	3 single-phase in ternature = "three-phase."
4	90°	2 single-phase in quadrature = "two-phase," or 4 single-phase in successive quadrature = "four-phase."
5	72°	5 single-phase in quinature = "five-phase."
6	60°	3 single-phase in ternature = three-phase with separate leads, or 6 single-phase in successive sexature = "six-phase," or 2 three-phase in sexature.
7	$51\frac{3}{7}$	7 single-phase in septature = "seven-phase."
8	45°	4 single-phase in successive octature = "four-phase" with separate leads, or 8 single-phase in successive octature = "eight-phase," or 2 two-phase in octature.
9	40°	3 three-phase in monature, or 9 single-phase in successive nonature = "nine-phase."

The general principles of conversion from polyphase to continuous currents, or *vice versâ*, are well known. The relation between the respective voltages on the alternating current side and the continuous current side have long ago been investigated, and expressions for their values in the several instances that may arise have been given for those cases in which it is assumed (*a*) that the alternating currents are simple sine functions of the time, and (*b*) that the magnetic flux is distributed as a sine function in space with respect to the periphery of the armature. Calculations for the voltages of two-phase and three-phase converters were given by Prof. Ayrton in the *Journal of the Institution of Electrical Engineers*, Vol. xxii., p. 340, in a discussion on April 27th, 1893. For the purpose of studying such machines they may be considered either as used to convert continuous currents into alternating, or as converting alternating into continuous. The latter function is of more frequent occurrence in practice; the former is rather more easy to follow out in thought. Taking, then, the instance of the converters as used to change continuous currents into alternating, and applying Prof. Ayrton's results to the several cases, we obtain the following numerical values. If we take the continuous currents as being supplied at a constant pressure of 100 volts, the voltmeter readings at the alternate current side will be as follows:—

Number of slip rings.	Angle between connections to rings.	Nature of service generated.	Voltage ratio.	Voltage (virtual volts).
2	180°	Single-phase	$\frac{1}{\sqrt{2}}$	70·71
3	120°	Three-phase	$\frac{1}{2}\frac{\sqrt{3}}{\sqrt{2}}$	61·23
4	90°	As two-phase	$\frac{1}{\sqrt{2}}$	70·71
4	90°	As four-phase	$\frac{1}{2}$	50·00
6	60°	As three-phase	$\frac{1}{2}\frac{\sqrt{3}}{\sqrt{2}}$	61·23
6	60°	As six-phase	$\frac{1}{2\sqrt{2}}$	35·35

A very complete discussion of the voltage relations, with formulæ applicable to the cases of open-coil windings as well as of closed-coil windings, was given by Herr R. M. Friese in the *Elektrotechnische Zeitschrift* of February 15th, 1894. Throughout the series of articles he assumes the sine values of the distribution of the magnetic flux around the periphery of the armature. More recently, Mr. Stein-

mets has reconsidered the same problem in the same journal in articles which appeared on March 3rd and 10th, 1898. From these theoretical considerations it is easy to write down, not only the voltages in the several cases, but also to calculate the corresponding relative values of the working currents in the armature and in the line wires. Similar calculations, down to a certain point, have to be made by every designer of polyphase motors. If we assume the above values for the voltages, and proceed to calculate the corresponding currents for an output of 10 kilowatts, we find the values of the currents generated to be as follows, the circuits being supposed non-inductive. Maximum as well as virtual values are given. Columns 4 and 5 refer to currents in the armatures, and columns 6 and 7 to currents in the lines. Star groupings are out of the question here, as they cannot be applied in armatures of converters. The only two-phase case that is possible is really a four-phase.

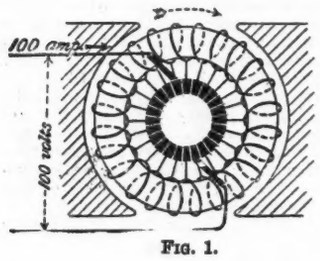


FIG. 1.

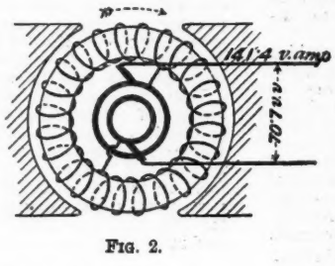


FIG. 2.

WORKING CURRENTS IN ALTERNATING ARMATURES.

No. of slip rings.	Angle between connections to rings.	Nature of service.	Armature current.		Line current.	
			Virtual.	Maximum.	Virtual.	Maximum
2	180°	Single-phase	70·7	100·0	141·4	200 0
3	120°	Three-phase	54 5	77 0	94·3	133·3
4	90°	Two-phase (four wires).	50 0	70·7	70·7	100 0
6	60°	Six-phase	47 2	66·7	47 2	66·7

If the circuits are inductive, there will be a lag of phase in the currents, and wattless currents as well as working currents. For an equal output of power, the numbers in columns 4 to 7 of the above table will need to be increased by dividing them by the cosine of the angle of lag.

Let us return to the problems presented by a converter, in which an armature, furnished with slip rings at one end and a commutator at the other, is wound with but one set of windings, receiving current as a motor and delivering it as a generator. The question for consideration is how the current, in the act of being transformed from alternating to continuous, or *vice versâ*, flows through the windings of the armature. This is a matter that has not hitherto been considered in detail in any publication. Considering the general case of a revolving armature which is at the same time being traversed by continuous currents to drive it as motor, and by alternating currents which it is putting forth as generator. It is self-evident that the currents which it receives as motor must be flowing, in general, against the electromotive forces induced internally by its rotation, while the currents which it gives out as generator must be flowing with those electromotive forces. Further, since at every instant (under steady conditions of operation) the value of the continuous current is (by hypothesis) unvarying, whilst the instantaneous value of the alternating current is continually changing, it is clear that at some instants the motor current must be in excess of the generator current, whilst at other instants the reverse must be the case. Whilst the average speed of rotation remains uniform it is certain that during each period, or revolution, there will at times be a positive acceleration, and at other times a negative acceleration. Further, it is clear that if there are any irreversible sources of loss of energy, such as friction, hysteresis, or eddy currents, the motor current must, on the whole, be greater than would otherwise be requisite, the power supplied at the motor side being greater than the output of power at the generator side, the difference being equal to the sum of the various items of power wasted in the machine.

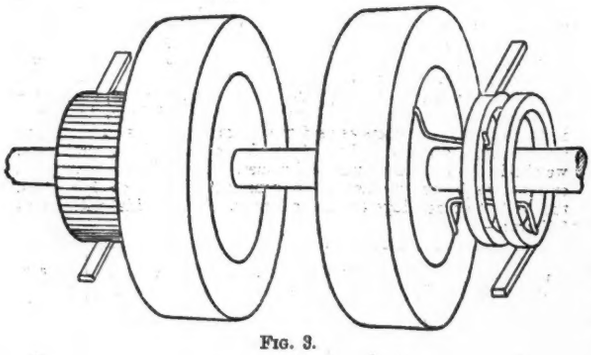


FIG. 3.

To make this clear, as well as to exhibit the way in which the circulation of current in the windings is effected, it is well to take some concrete case. All cannot follow an analytical argument; and therefore, though the analytical treatment has many advantages, I have deliberately preferred, for the purposes of the present paper, to avoid formulæ (though they have been used in its preparation), and, instead, to exhibit the arguments numerically by taking specific cases that are readily followed.

Let us consider a 10-kilowatt bipolar ring armature, having at its periphery 96 conductors, connnected symmetrically down to a 48-part commutator, running at 1,200 revolutions per minute, or 20 revolutions per second. There will be two turns of the winding between each commutator bar and the bar next adjacent. (Or the armature might be wound as a lap-wound drum, with two conductors to constitute each element of the winding). That it may run as a 100-volt continuous current machine the magnetic flux through the armature core must be 5,208,333 lines, or a little over 5 megalines. Fig. 1 will serve to represent diagrammatically this armature when receiving 100 amperes at 100 volts, and running as a motor. The flow of current in the armature winding will, of course, be 50 amperes in each half of the ring.

Now, suppose a precisely similar armature to be revolving in a precisely similar field, but let its windings be connected at two diametrically opposite points to two slip rings on the axis. If driven by power it will generate an alternating current. As the maximum voltage between the points that are connected to the slip rings will be 100 volts, and the virtual volts (as measured by a voltmeter) between the rings will be 70·7 ($= 100 \div \sqrt{2}$), if the power applied in turning this armature (fig. 2) be 10 kilowatts, and if the circuit is non-inductive, the output in virtual amperes will be 10,000 ÷ 70·7 = 141·4. If the resistances of each of the armatures is negligibly small, and if there are no frictional or other losses, the power given out by the armature which serves as motor will just suffice to drive the armature which serves as generator. Accordingly, let us suppose them both mounted upon the same shaft, as in fig. 3, and placed so that each lies in a similar and equal bipolar magnetic field. We have here the well-known combination of a *motor-dynamo*.*

(To be continued.)

THE INSTITUTION OF CIVIL ENGINEERS.

ABSTRACT OF PRESIDENTIAL ADDRESS OF WILLIAM HENRY PREECE, C.B., F.R.S.†

(Concluded from page 724.)

ELECTRO-CHEMISTRY.

The transference of electricity through liquids is accompanied by the disintegration of the molecules of the liquids into their constituent elements. The act of conduction is of the nature of work done. Energy is expended upon the electrolyte to break it up, and the quantity thus chemically decomposed is an exact measure of the work done. Every electrolyte requires a certain voltage to overcome the affinity between its atoms, and then the mass decomposed per minute or per hour depends solely upon the current passing. The process is a cheap one, and has become general. Three electrical H.P. continuously applied deposit 10 lbs. of pure copper every hour from copper sulphates at the cost of 1d. All the copper used for telegraphy is thus obtained. Zinc, in a very pure form, is extracted electrolytically from chloride of zinc, produced from zinc blende, in large quantities. Caustic soda and chlorine are produced by similar means from common salt. The electroplating of gold, silver, and nickel is a lucrative and extensive business, especially in Birmingham and Sheffield. Gold and silver are refined by this electrolysis in Russia, and nickel in the United States. Sea water is decomposed in this way for disinfecting purposes by the Hermite process.

The passage of electricity through certain gases is accompanied by their dissociation, and by the generation of intense heat. Hence the arc furnace. Aluminium is thus obtained from cryolite and bauxite at Foyers by utilising the energy of the falls. Phosphorus is also separated from apatite, and other mineral phosphates. Calcium carbide, obtained in the same way, is becoming an important industry.

It is remarkable that our coalfields have not been utilised in this direction. Electrical energy can be generated on a coalfield, where coal of good calorific value is raised at a cost of 3s. per ton, cheaper than by a waterfall, even at Niagara.

* The term *dynamotor* is not only philologically bad, but is a misdescription. When two machines, of whatever kind, are thus coupled together, it is always the motor which drives the dynamo, not the dynamo which drives the motor.

† Delivered Tuesday, November 1st, 1898.

Electro-metallurgy is now a very large business, but it is destined to increase still more, for the generation of electrical energy is becoming better understood and more cheaply effected.

The Transmission of Power.

The energy wasted in waterfalls is enough to maintain in operation the industries of the whole world. Great cities, as a rule, are not located near great falls, nor has a beneficent Providence provided great cities with waterfalls, as, according to the American humourist, He has with broad rivers. There is but one Niagara, and we are seeing how industries are rather going to the falls than the energy of the falls is being transmitted to the industrial centres. The arbitrament of money is limiting the distance to which energy can be profitably transmitted. The Cataracts of the Nile can be utilised in irrigating the waste lands of the upper regions of the river, but their energy cannot compete, at Alexandria, with that of coal transported in mass from England.

At Tivoli, 15 miles across the Campagna, the energy of the falls are economically utilised to light Rome and to drive the tramways of that city. The electric railways at Portrush and Bessbrook, in Ireland, are worked by water-power, and Worcester, Keswick and Lynton, use it in this country, but on a very small scale. It is not used more, for the simple reason that there are no more falls to use. Water-power is used very extensively in Switzerland, because it is so abundant there, and in our colonies, especially in South Africa; but it is in the United States, especially in Utah and California, where the greatest works have been installed especially for the transmission of energy to mines.

In mines electricity is invaluable. It is used for moving trams and for working hoists. It lights up and ventilates the galleries, and by pumping keeps them free of water. It operates the drills, picks, stamps, crushers, compressors, and all kinds of machinery. The modern type of induction motor, having neither brushes nor sliding contacts, is free from sparks and safe from dust. Electrical energy is clean, safe, convenient, cheap, and it produces neither refuse nor side products. It is transmitted to considerable distances. In mountainous countries the economical distance is limited by the voltage which insulation can resist; 40,000 volts are being practically used between Provo Canyon and Mercur, in Utah, in transmitting 2,000 H.P. 32 miles.

The following Table records some interesting installations:—

Place.	Electric power generated.	Pressure on line.	Distance transmitted.	Remarks.
	Kilowatts.	Volts.	Miles.	
Eschdorf-Grünberg, Schleswig	225	10,000 (three-phase)	15	One 80-H.P. Siemens and Halske dynamo, driven from water-wheel; one 220-H.P. S. & H. dynamo, driven from turbines (above driven through counter-shafting); one 220-H.P. S. and H. dynamo, direct-coupled to engine.
Ogden, Salt Lake City, Utah	3,750	15 000 (three-phase)	36	Plant consists of five 1,000 H.P. twenty-four-pole three-phase generators, driven by Knight water-wheels running at 300 revolutions per minute.
Big Cottonwood, Utah	1,800	10,000 (three-phase)	14	Plant consists of four 450-kilowatt three-phase General Electric generators, each one directly coupled to a Pelton wheel.
Folsom-Sacramento, California	3,000	11,000 (three-phase)	22½	Plant consists of four 1,000-H.P. three-phase generators built by the General Electric Company, coupled direct to the turbine shafts.
San Antonio Creek to Pomona To San Bernardino, California	480	10,000 (single phase)	13¾ 28¾	Plant consists of four 120-kilowatt twelve-pole Westinghouse alternators, driven by a Pelton water-power plant.
Rand Central Electric Works, Brakpan to Johannesberg, Transvaal	3,200	10,000 (three-phase)	18	Plant consists of four S. & H. rotary-phase machines, coupled direct to 1,000 H.P. to 1,200 H.P. engines.

It is effecting a great economy in coal consumption in our workshops and factories. The efficiency of steam-driven shafting is known to be very poor. Scattered steam engines and long steam piping run away with money by their continuous waste of energy. The motor is used only when and where it is wanted, its efficiency is very high, and it costs nothing when it is idle. It can be used either for the small power required by machines and tools at present worked by hand, or for a goods locomotive of 2,000 H.P., such as is now being used at Baltimore.

This utilisation of energy at a distance is reinstating many home industries, to the great advantage of the working classes, whose time is wasted in long excursions to the factory, and whose health, morals, and well-being are not improved by herding in great numbers and by incessant association with the grievance-monger and the professional agitator.

Conclusion.

I have touched lightly—I fear too lightly—upon some of the applications of electricity. I have confined myself, in a very general sense, to those with which I have been personally associated. I have shown how electricity began its beneficent career by protecting our lives and property from the disastrous effects of Nature's dread artillery, how it facilitates intercommunication between mind and mind by economising time and annihilating space. It

> "Speeds the soft intercourse from soul to soul,
> And wafts a sigh from Indus to the Pole."

By its metallic nerves it brings into one fold not only the scattered families of one nation, but all the countries and all languages, to the manifest promotion of peace and general goodwill. Not only does it show us how to utilise the waste energies of Nature, but it enables us to direct them to the place where they are most wanted, and to use them with the greatest economy. It opens to our view Nature's secret storehouses, presenting us with new elements, new facts, and new treasures. It economises labour, and purifies material. It lightens our darkness in more senses than one, and by enabling us to see the unseen, it tends to aid the gentle healing art, and to alleviate both suffering and pain. It aids us in the pursuit of truth, and it has exploded the doctrine that the pursuit of truth means the destruction of faith.

I have occupied your time sufficiently, I hope, to impress upon you the universality of electricity. Its flood-gates were opened when our good Queen ascended the throne, and during her glorious reign it has overflown all the fields cultivated by the engineer. Though its followers are now regarded as specialists, the period is not distant when it must cease to be a speciality. Its facts and tenets, its science and practice, must form the framework of the profession of the engineer. Every engineer must ultimately become an electrician, and electricity will be the most general, the most useful, and the most interesting form in which he applies the fundamental principles of energy to the wants, the comforts, and the happiness of mankind.

PHYSICAL SOCIETY.

Ordinary Meeting, November 11th, 1898.

Mr. Shelford Bidwell, F.R.S., President, in the Chair.

The discussion on Mr. Albert Campbell's paper on "The Magnetic Fluxes in Meters and other Electrical Instruments," was resumed.

Prof. Ayrton said he wished to offer some remarks on behalf of Mr. Mather and himself. The paper would perhaps have received more adequate discussion at the Institution of Electrical Engineers, for it was chiefly of a technical character. The importance of neutralising the effect of leads when using instruments with very weak fields, such as a Siemens electro-dynamometer, should be emphasised. In instruments of the Kelvin balance type, where two opposed coils carry two opposed currents, the field spreads at the edges; the true "working" flux is not that directly between the coils. Mr. Campbell would have done better if he had used a long search coil wound round one of the swinging coils, forming part of a vertical cylinder. It would have been well also to have supplied some experimental proof that the astatic arrangement of the swinging coils of the Kelvin balance makes the instrument independent of the earth's field. The effect of the earth's field is of the order 0·2, so that with instruments of the Weston type, with a field of the order 1,000, it was sometimes assumed, erroneously, that the readings were practically independent of the earth's H. Prof. Ayrton's own tests showed that by turning a Weston voltmeter towards different points of the compass, the errors in a particular case were far greater than might be predicted from the above ratio; the induction in the voltmeter pole space, due to the earth's field, was much higher than 0·2; the earth's field was exaggerated by the iron pole pieces; it was not necessary to suppose that the magnetism of the permanent magnet caused the variation. The error observed was about 0·2 per cent. in a horizontal field, and 0·8 per cent. when the field of the voltmeter was parallel to the earth's induction. Here the induction in the gap was 1,200, and H = 0·2. In tests relating to the Ayrton and Perry magnifying spring voltmeter, it was more important to know the B in the air space *near* the iron than the B *within* the iron. Eddy currents might account for the extraordinary results obtained with the Shallenberger meter.

Mr. J. H. Reeves described a method he had adopted for measuring the effect of stray fields upon ammeters and voltmeters. The instrument to be tested is first mounted on a stand, and is brought under the influence of a large coil carrying a current. In this way fields of known magnitude can be superimposed on the working field

throughout the range of the instrument, and the change of deflection due to them can be observed. From these known values the working field can be deduced; for let the current in the solenoid of the instrument at any moment be A amperes, producing a corresponding unknown working field of magnetic force, X. Then X is proportioned to the solenoid current, as measured by the indications of the instrument. If a magnetic force, x, is superimposed on X, then x is measured by x/X of A. If x is known, the working field, X, can be calculated from the change of deflection produced by the superposition. With Evershed ammeters, the field measured in this way was, in one instrument, 200, and in another, 226, or about one-third of Mr. Campbell's figure (700) for the Evershed ammeter. Mr. Campbell's value of B did not represent the working field, but the field at the end of one of the fixed pieces of iron.

Mr. CAMPBELL, in reply, said he thought the theory of electrical instruments to be well within the limits of physics, and he had for that reason presented the paper to the Physical Society. The position chosen for the search coil in the Kelvin balance tests may not have corresponded to the working flux, but it was near to the right position, and he had carefully specified the position chosen. His results as regards the Weston instrument differed from those of Prof. Ayrton; the errors he had observed for the particular ammeter used were under 0·1 per cent. The earth's field probably produced an effect different for different Weston instruments, according to the degree of saturation of the permanent magnet. In Mr. Campbell's tests the Weston instrument did not have an iron case.

A PAPER by Prof. W. B. MORTON on "THE PROPAGATION OF DAMPED ELECTRICAL OSCILLATIONS ALONG PARALLEL WIRES" was then read by Prof. J. D. EVERETT.

In a paper published in the *Phil. Mag* for September, 1898, Dr. E. H. Barton compared the attenuation of electrical waves in their passage along parallel wires, as experimentally determined by him, with the formula given by Mr. Heaviside in his theory of long waves. He finds close agreement as regards the effect of a terminal resistance, but large discrepancy in the case of the attenuation constant. Prof. Morton now investigates how far the results should be modified when it is supposed, as under actual conditions, that the oscillations propagated from the origin are damped, and that the circuit is not balanced, as in the ideal case of distortionless transmission. He finds (1) that the velocity of propagation is increased, while (2) the attenuation is increased, and (3) with infinite resistance between the ends of the wires, the waves are, as before, reflected completely with phase unchanged. As the resistance is diminished the amplitude of the reflected waves is decreased, and a phase difference is introduced. For a certain value of the resistance, the reflected amplitude is a minimum, and the phase difference is $\pi/2$. When the resistance is zero, there is again complete reflection, with phase difference π; *i.e.*, the waves are reversed. The result is that the reflection factor for amplitude *seems* to pass continuously from $(+1)$ to (-1) *without* passing through zero. Using the numbers given by Dr. Barton, it is found that the corrections to the simple theory are extremely small, so that in actual cases the damping may be ignored, and the circuit may be regarded as distortionless.

Mr. OLIVER HEAVISIDE (abstract of communication).—Mr. Heaviside, using his own notation, exhibits mathematically the connection between the case investigated by Mr. Morton, of a wave train arising from a damped source, and the standard case of an undamped source. The cause of the attenuating coefficient coming out twice as great in Dr. Barton's experimental condition, as when the resistance is calculated by Lord Rayleigh's formula, is attributed to lack of correspondence between the experimental conditions and those of the ideal theory. For: (1) The external resistance of unknown amount is ignored. (2) It is not certainly to be expected that the formula in question is true for millions of vibrations per second. It may, however, be concluded from the experiments that the theory furnishes an approximation to the real resistance. (4) The magnetic vibrations to which the wires are subjected are not long continued and undamped as assumed by the formula. When a wave train passes any point on a wire, its surface is subjected to an impulsion vibration, lasting only a very minute fraction of a second; a vibration, moreover, which is very rapidly damped. So there is no definite resistance, and the resistance is greater than according to Lord Rayleigh's formula. (5) Perhaps, also, the terminal reflections involved in Dr. Barton's calculations may introduce error.

The PRESIDENT proposed votes of thanks to the authors, and the meeting was adjourned until November 25th.

THE THEORY OF THE ACCUMULATOR.

THE electro-chemical theory developed chiefly by Nernst is not so much in vogue here as on the Continent. Its application, however, has given satisfactory explanations of most of the phenomena of electrolysis, and we think, therefore, that a summary of an article in the *Elektrotechnische Rundschau*, October 15th, in which Prof. Hoppe, of Hamburg, applies this theory to accumulators may be of interest to our readers.

It is now 10 years since two works appeared which have given a new turn to our views of the electric current and its accompanying chemical reactions. These works were that of Van't Hoff on osmotic pressure, and that of Arrhenius on dissociation. The law of Van't Hoff, which holds for all solutions, may be expressed as follows:—"The osmotic pressure of substances in solution is the same as their gaseous pressure at the same temperature and volume." All electrolytes show apparent deviations from this law, which, however, are completely explained on the assumption that a certain percentage only of the molecules in solution are dissociated. The conductivity of a liquid is directly proportional to the number of these dissociated molecules, so that we can say with Arrhenius that a current of electricity is conducted through an electrolyte by the dissociated molecules only. The dissociated molecules form the ions which constitute the current. Without dissociation, therefore, no chemical action of the current is possible, nor can a current be produced by chemical forces, for chemical action is as necessary for the production of current as for its conduction. The theory of the accumulator, must, therefore, be built up on this foundation, and many of the earlier theories, in this view, become untenable.

Quite independently of theoretical considerations, we start with the experimentally established fact, that in the lead accumulator, during the charging, peroxide of lead is formed on the positive plate, and pure lead on the negative plate; while during discharge, sulphate of lead is formed on both plates. These results have now been established beyond doubt by thousands of experiments.

In order to clearly understand the chemical processes of the charge and discharge, Nernst's theory of current production must be made use of. When an accumulator is supplying current, its action is exactly like that of any other battery; there is no special condenser-effect as was at one time supposed.

According to the theory of Nernst, if a metal is dipped in water, or in an acid, part of the metal goes into solution; the force which causes this passage of the metal ions into the solution, Nernst calls *solution-tension*. If the solution-tension is greater than the osmotic pressure, the positive metal ions pass into the solution; negative electricity is thus set free on the metal plate, the positive ions of the solution form a positive superficial layer, and an E.M.F. opposed to that of the metal plate is developed, which prevents the further passing of metal ions into the solution, until the negative electricity is drawn off by closing the external circuit. If the solution-tension is equal to the osmotic pressure no current is produced. If the osmotic pressure is greater than the solution-tension, the positive metal ions pass from the solution to the metal plate, setting free negative electricity on the surface of contact of the solution, thereby giving rise to a counter E.M.F., as in the first case.

Since osmotic pressure follows the same law as gas pressure, Nernst assumes like properties for the solution-tension; it becomes thus possible to calculate the effect of both by the same formula, and to compare the results with measurements obtained by experiment. The agreement between calculated and experimental results has been in every case remarkable, so that there can now be no doubt that this theory indicates the true source of the E.M.F. of an element, and that the contact E.M.F., which was formerly considered of primary importance, contributes to the total E.M.F. only an infinitesmal amount. For example, according to the measurements of Le Roux, the contact force Cu — Zn = — 0·00044 volt, while Cu — Cu SO_4 with 80 per cent. dissociation, gives — 0·582 volt, and Zn — Zn SO_4, with the same percentage of dissociation, gives + 0·521 volt.

For the evaluation of an element, it is not sufficient to know this E.M.F.; another factor is required.

If an element having the electromotive force E, and temperature T, performs external work π, a chemical reaction has taken place in the cell whose heat of combination may be called g. At first it was assumed with Thomson that $g = \pi$ in all cases; but Helmholtz showed that such is not necessarily the case, but that $g - \pi$ may be positive or negative, as well as equal to zero. If the temperature of an element rises from T to T + dT, while external work $d\pi$ has been performed, then $d\pi = (\pi - g)\frac{d\,T}{T}$, *i.e.*, $\pi - g = T\frac{d\,\pi}{d\,T}$. This factor $\frac{d\,\pi}{d\,T}$ is called the temperature coefficient. It

must be first determined before we can test the theory by calculation from the chemical reactions. Streintz has done this for the accumulator, and he has shown that its temperature coefficient is very low, and that chemical reactions during charging and discharging are represented by the following equations:—

Discharging: $PbO_2 + 2H_2SO_4 + Pb = 2PbSO_4 + 2H_2O$,
Charging: $2PbSO_4 + 2H_2O = PbO_2 + 2H_2SO_4 + Pb$.

The E.M.F. calculated from the heats of combination of the above reactions is almost exactly the same as the actual E.M.F. of the accumulator. Streintz found by calculation an E.M.F. of 1·88 volt, while that obtained by direct measurement is 1·9 volt. If, however, this chemical reaction correctly represents that of the accumulator, then the accumulator is perfectly reversible, *i.e.*, there is no loss of energy in charging and discharging. As a matter of fact, there is always 15 to 20 per cent. loss of energy in charging and discharging accumulators; moreover, an accumulator, after a discharge, "recovers itself" after the lapse of some time, *i.e.*, after a stoppage of the discharge a higher E.M.F. is shown.

On account of this loss of energy, it has been assumed, that the reaction in the accumulator is not reversible, and that the formation of sulphate of lead is due to a secondary decomposition. The theories of Darrieus and Elbs gave expression to this idea. Darrieus assumes that on the charged positive plate, there is, besides PbO_2, persulphuric acid ($H_2S_2O_8$). In charging, the persulphuric acid performs the function of changing the sulphate of lead or the oxide of lead into peroxide. In discharging, however, only Pb_2O is formed directly on the negative plate; this sub-oxide decomposing by a secondary reaction into $PbSO_4$ and Pb owing to the presence of sulphuric acid. In like manner, at the positive plate, the primary reaction is the reduction of PbO_2 into PbO, while the transmutation of PbO into $PbSO_4$ takes place as the result of a secondary reaction. This theory has been demolished by the investigations of Elbs and Schönherr on the electrolysis of sulphuric acid, they having demonstrated (1) that the density of current employed in charging accumulators is capable of producing only very small quantities of persulphuric acid; and (2) that the presence of persulphuric acid is not a necessity but a hindrance in the charging of accumulators.

Elbs himself, however, considers that discharge reactions are partly secondary, since he assumes that the PbO_2 of the positive plate is first decomposed by two molecules of hydrogen into $PbO + H_2O$, and then that the H_2SO_4 by a secondary reaction converts the PbO into $PbSO_4 + H_2O$. This secondary decomposition would, certainly, explain the loss of energy; but Dolezalek has shown that a sufficient explanation of the loss may be found in physical causes.

If two accumulators, of exactly similar constitution, except that they differ in the concentration of their acids, are connected up in opposition in the same circuit, they produce only the current due to the difference of the heats of mixing of the H_2SO_4 and H_2O in the two solutions. The reaction takes place in the same way, as if H_2SO_4 was transported from the more concentrated solution into the less concentrated, and H_2O in the opposite direction, *i.e.*, the process is reversible. Now, it is self-evident that in the actual accumulator the concentration of the acid in the electrodes and in the free acid must be different owing to the penetration of the acid into the pores of the plate. Diffusion is not capable in the case of strong electrolysis of instantaneously equalising the differences of concentration. Differences of concentration must therefore arise, and it is to these that the loss of energy is due. But if we take into consideration these concentration currents there is no loss of energy left to be attributed to secondary decompositions, and the chemical reactions in the accumulator must be looked upon as reversible.

The energy dissipated by the concentration currents may be represented by the formula $c\frac{\gamma}{K}J^2t$, where c is a constant, γ a factor depending on the construction of the accumulator, K the mean conductivity of the acid in the pores, J the strength of the current, and t the time. K is a function of J, and for the calculation K may be regarded as constant, and BJ^2t may be taken as a convenient expression for the loss of energy.

Le Blank attempts to explain the reactions in this reversible charging and discharging by the help of tetrad lead ions. Tower has shown that when peroxide of manganese is dissolved in sulphuric acid, that it decomposes into one manganese and four hydroxyl ions; manganese must therefore be in this case a tetrad. In the same way, PbO_2 splits up into tetrad Pb and OH ions. These tetrad Pb ions give up half their charge to the electrodes, and combine as dyads with SO_4 to form sulphate of lead, while the OH ions combine with the H ions of the dissociated sulphuric acid to form H_2O. To the negative electrode, on the other hand, metallic lead passes over, in dyad ions, which combine directly with SO_4 ions to form sulphate. In the charging reaction the dyad Pb ions of the sulphate at the anode change into tetrad ions which form, with 4 HO ions, the hydrate of PbO_2, while at the cathode, the dyad lead ions change directly into metallic lead. Though the assumption of tetrad Pb ions offers no difficulty, Hoppe considers the assumption of the splitting up of PbO_2 at the anode by the discharge, and the formation of $PbSO_4$ is not possible without secondary decomposition, and this would imply, though the loss of energy might be small, that the charging and discharging was not strictly reversible.

Liebenow's theory furnishes us with a completely reversible process. In alkaline solutions of lead, the splitting up of the $Pb(OK)_2$ and $Pb(ONa)_2$ takes place in such a way that PbO appears as anion, and 2 K or 2 Na as cation. If the 2 K or 2 Na is replaced by divalent Pb, PbO_2 may be imagined as anion and Pb as cation. It would, then, only be necessary to assume that these PbO_2 and Pb ions are present in the dissociated condition in the solution. How they come out of the layer of sulphate into the solution may be represented by the following assumption:—$4H_2O + 2PbSO_4 = 4HO + 4H + 2Pb + 2SO_4 = PbO_2 + Pb + 2H_2O + 4H + 2SO_4 = PbO_2 + Pb + 2H_2O + 4H + 2SO_4$. Thus the charging current finds in the solutions, as negative dissociated ions PbO_2 and SO_4; and as positive dissociated ions Pb and H. Of these, the PbO_2 and Pb ions require the smallest amount of work for their separation, therefore, with small current densities they will be first separated, while the acid ions are essential for the conductivity. For this very simple theory, proof of the actual existence of PbO_2 ion is indispensible; for on this the whole theory rests.

The proof of the existence of PbO_2 ions was furnished at the instigation of Liebenow by Strasser, not, indeed, in sulphuric acid, because in that, the ions are not permanent, but in potassium lye. PbO_2K_2 may be dissolved in water, and the splitting up of the double oxide, $PbO + K_2O$, into ions may be pictured in accordance with the scheme: $Pb(OH) + 2KOH = \overset{++}{Pb} + 2\overset{+}{K} + 4(\overline{OH})$, but also as a solution of potassic plumbate with the ions $= 2\overset{+}{K} + \overline{\overline{PbO_2}}$. In the first case Pb wanders with K in the direction of the current, in the second case against the direction of the current as anion. In the electrolysis of the normal potassium lye saturated with lead oxide, Strasser found the lead always as a precipitate on the anode, *i.e.*, it was derived from the constituents of the negative ion. The existence of PbO_2 ions in alkaline solutions, as anions, can therefore not be denied. Löb also asserts the existence of PbO_2 ions in organic salts of lead. If we further recall, that Classen looks upon MnO_2 as a negative ion in the dissociation of manganese oxide, there appears to be no ground for doubting the existence of PbO_2 ions.

If, now, PbO_2 ions occur in acid solutions, the chemical reactions in the accumulator, during charging, can be represented, with certainty, in the following way:—The two electrodes are $PbSO_4$; in the solution are present $H_2SO_4 + H_2O + (PbO_2) + (H) + (SO_4) + (Pb)$, the last four as dissociated ions. The current separates out PbO_2 upon the anode, and Pb upon the cathode, the $PbSO_4$ replaces, by the above described decomposition, the PbO_2 and Pb ions.

For the discharge, we have $+ [PbO_2 + 4(H) + 2(SO_4) + (2H) + (SO_4) + Pb] -$, where H represents the positive, and SO_4 the negative ions; at the end of the discharge we have $+ [PbSO_4 + 2H_2O(SO_4) \ldots\ldots + 2(H) + PbSO_4] -$.

The lead accumulator will thus be a perfectly reversible element working without loss of energy as soon as means

have been discovered to prevent the occurrence of concentration currents. The only way, therefore, in which we can hope to improve the efficiency of the accumulator is by directing our attention to the diminution of concentration currents; all other means of attaining our end are useless.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1898.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, *to whom all inquiries should be addressed.*

22,820. "Improvements in the means of propelling tramcars by electricity." J. Enright. Dated October 31st.

22,828. "Improvements in the method of arranging and distributing underground wires in connection with telephone systems." A. Watts. Dated October 31st.

22,836. "Improvements in electric switches." H. Simon. Dated October 31st.

22,858. "Combined apparatus for regulating the supply of electricity to lamps, motors, and other electrical apparatus." E. E. Prestwich and L. N. Burt. Dated October 31st.

22,870. "Improvements in electricity meters." S. B. Apostoloff. Dated October 31st.

22,872. "Improvements in electrolytical apparatus." J. Louselet. Dated October 31st.

22,887. "Improvements in arc lamps." A. B. Barnikol-Veit and A. W. Riebel. Dated October 31st. (*Complete.*)

22,928. "Improvements in arc lamps." W. G. Heys. (H. J. Linder, United States.) Dated November 1st.

22,936. "An arrangement to act as a meter for one or more electric lamps, the object being to register the time during which the lamp or lamps burn." Baird & Tatlock. Dated November 1st.

22,959. "Improvements in telegraphic apparatus." F. W. Golby. (J. de Constant, Germany.) Dated November 1st. (*Complete.*)

22,964. "Improvements in plug switches or wall contacts for electric circuits." A. Vandam and T. H. Marsh. Dated November 1st. (*Complete.*)

22,987. "Improvements in electric arc lamps." A. Stuttman. Dated November 1st.

23,000. "Automatic regulator for electric currents." C. D. Abel. (F. Back, Austria-Hungary.) Dated November 1st.

23,043. "Improvements in the construction of electrical resistance balances or bridges." J. A. Fleming. Dated November 2nd.

23,066. "Improvements in and connected with telephonic fire-alarm and time indicating apparatus." S. B. Apostoloff. Dated November 2nd.

23,138. "A vacuum contact arc lamp." P. Spies, E. L. O'Brien, R. F. B. Lennard, and R. Heywood. Dated November 3rd.

23,143. "Improvements in electrical warming pans and like articles." W. Buck. Dated November 3rd.

23,155. "Improvements in electric rail brakes and electro-magnets therefor." H. H. Leigh. (Gesellschaft zur Verwerthung, elektrischer und magnetischer, Stromkraft (system Schiemann and Kleinschmidt), A. Wilde & Co., Germany.) Dated November 3rd.

23,160. "Improvements in transformer switches." A. Schlatter. Dated November 3rd.

23,183. "Improvements in electrical switches." W. H. Sturge. Dated November 4th.

23,207. "Improvements in electrical heating and melting, specially applicable to the metal pots of linotype machines." W. H. Lock, J. Place and M. Barr. Dated November 4th.

23,233. "Improvements relating to electric railways and tramways provided with sectional conductors or surface contacts." J. Wetter. (The Elektrizitats-Aktiengesellschaft vormals Schuckert and Co., Germany.) Dated November 4th. (*Complete.*)

23,234. "Improvements in or connected with electric railways and tramways provided with sectional conductors or surface contacts." J. Wetter. (The Elektrizitats-Aktiengesellschaft vormals Schuckert & Co., Germany.) Dated November 4th. (*Complete.*)

23,243. "Improvements in and relating to electric accumulators." P. Ribbe. Dated November 4th. (*Complete.*)

23,249. "An improved primary battery for generating electricity." C. H. Preston. Dated November 4th.

23,265. "Improvements in glow lamps and holders." E. J. Preston. Dated November 5th.

23,306. "Improvements in or relating to galvanic batteries." C. Levetus. Dated November 5th.

23,307. "Improvements in or relating to galvanic batteries and the like." C. Levetus. Dated November 5th.

23,320. "Electro-magnetic safety apparatus for lifts, mining cages, and the like." F. W. Golby. (W. Suermondt, Germany.) Dated November 5th.

23,327. "An improved driving mechanism for phonographs, kinetographs, and the like." J. S. August and J. Cohn. Dated November 5th. (*Complete.*)

23,334. "Improvements in electricity meters for continuous and alternating currents." A. Peloux. Dated November 5th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P Thompson & Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, *price, post free,* 9d. (*in stamps*).

1898.

10,690. "Improvements in starting devices for single-phase alternating electric current motors." The British Thomson-Houston Company. (J. P. Stone, S. E. Doane.) Dated May 10th, 1898. Relates to apparatus for starting single-phase alternating electric current motors. To carry out the purpose of this invention is employed a resistance, but instead of an ordinary inductance is employed a transformer or compensator, or auto-transformer, and the proportions of the windings and the connections of the motor that the voltages may be in any proportions desired. The invention comprises two phase-displacing devices in series across the mains, and in shunt to the motor, the motor has three terminals, two of which are connected to a source of single-phase current, directly or inductively, and the third terminal is connected to the mains through phase-displacing devices consisting of a resistance and step-up transformer in series across the mains. 3 claims.

11,783. "Improvements in and relating to conductors for electrical railways." H. H. Lake. Dated May 24th, 1898. Relates to trolley rail for use with cars carrying electric motors. The trolley rail is normally out of contact, but when moved horizontally is thrown into contact. The contact shoe of the car is able to push downwards, forwards, or backwards. So that by pushing downwards and then either forward or backward, the rail can be moved, thus causing contact. Beneath the contact rail a continuous insulated conductor is laid. At points along the line a piece of conducting material is surrounded by a cylindrical tube and connected to the conductor. In the tube projecting beyond this piece of conductor, conducting pistons are arranged at each end and they are connected to the rail. At each end of the rail a spring with follower is attached to the contact rail. Therefore, when the contact shoe of the car pushes the rail along the springs are either compressed or expanded, and one of the pistons touches the piece of conducting material, thereby connecting the conductor to the car, and the circuit is completed by the wheels or any other method. When the car moves off that section the spring moves the rail back into the normal position till the contact shoe repeats the operation on the next section. The rail rests on friction rollers. 2 claims.

12,350. "Improvements in electrical alarums." Siemens Bros. and Co., Ltd., and J. Ebel. Dated June 1st, 1898. By a spring and clockwork arrangement a starwheel is made to revolve approximately regular when a key is pressed. As each arm touches a spring it makes contact, and a current is sent through a solenoid wound on a non-conducting tube. Fitted in the tube is an iron tube which forms a core and would be free to move if it were not for a spring fastened to one end of the core and to a non-conducting arm. Over all is fixed a large gong. When the current passes through the solenoid the core is attracted into it and hits the gong on one side. Directly the current ceases the springs pulls the core back and it hits the gong on the other side. The circuit is made up of a battery, the solenoid and the metal of the clockwork and the blade spring. 1 claim.

12,680. "Improvements relating to electric alternating current cable systems." F. Clouth. Dated June 6th, 1898. Relates to a method of increasing the capacity in an alternating current system for the purpose of diminishing the difference in the phases by the introduction of an interchanging or cross-connection arrangement of concentric alternating current cables, in such a manner that the inner conductor is connected in a certain length with the outer conductor of the adjoining length, and the outer conductor of this second length connected with the inner conductor of the following length, and so on through the whole system. 1 claim.

13,010. "Improvements in electric arc lamps." The British Thomson-Houston Company, Limited. (R. Fleming.) Dated June 9th. Relates to arc lamps, and particularly those designed for use on alternating current circuits. The main body of the lamp comprises a rectangular cast metal frame, to which is screw-threaded at its upper end a tube. This tube furnishes a support for the metal top, and at the same time surrounds and protects the upper carbon pencil. On the upper end of the tube is mounted a cap which is provided with an insulating spool for insulating the suspension ring from the body of the lamp. Mounted in the metal tops are binding posts; these posts are insulated from each other and the top by insulating bushing and collars in the ordinary manner. The circuit through the lamp is controlled by means of the switch, which is mounted on the top of the lamp, and is insulated from it. 20 claims.